AMERICAN MACHINIST

A JOURNAL FOR MACHINISTS, ENGINEERS, FOUNDERS, BOILER MAKERS, PATTERN MAKERS AND BLACKSMITHS.

VOL. 17, NO. 26 WEEKLY. | NEW YORK, THURSDAY, JUNE 28, 1894. | $3.00 per Annum. SINGLE COPIES 6 CENTS.

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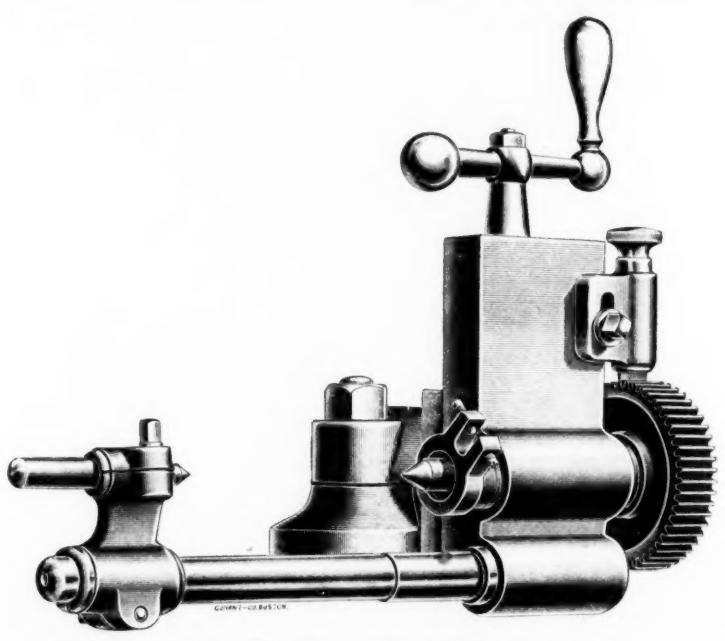
Index Milling Attachment for Lathes.

The accompanying engraving shows a very simple attachment that can be used on any engine lathe or cross slide of turret lathe or screw machine, and that will enable toolmakers to flute taps, reamers, etc., make cutters, "slab" bolts, slot screws, or do other light milling required in a tool room or small shop. The attachment will mill work 6½ inches long and 2¾ inches in diameter; it is held on the lathe carriage in place of tool-post by means of a steel bolt furnished, and the construction is such that back center can swing to one side, or be raised or lowered before clamping for milling angles and tapers. When in use, the arm supporting back center projects across the lathe on left-hand side of carriage; the tool to be milled is held on the centers of attachment and the cutter is revolved in lathe, preferably on an arbor fitted to taper hole in spindle. Index plates are not furnished, as it is designed to use the change gears of lathe on which it is used, giving a wide range. The stop pin is adjustable so that it can be used with any size of gear. For larger work, such as cutters, gears, etc., the arm can be removed and work held on taper-shank arbors fitted to spindle.



MILLING ATTACHMENT.

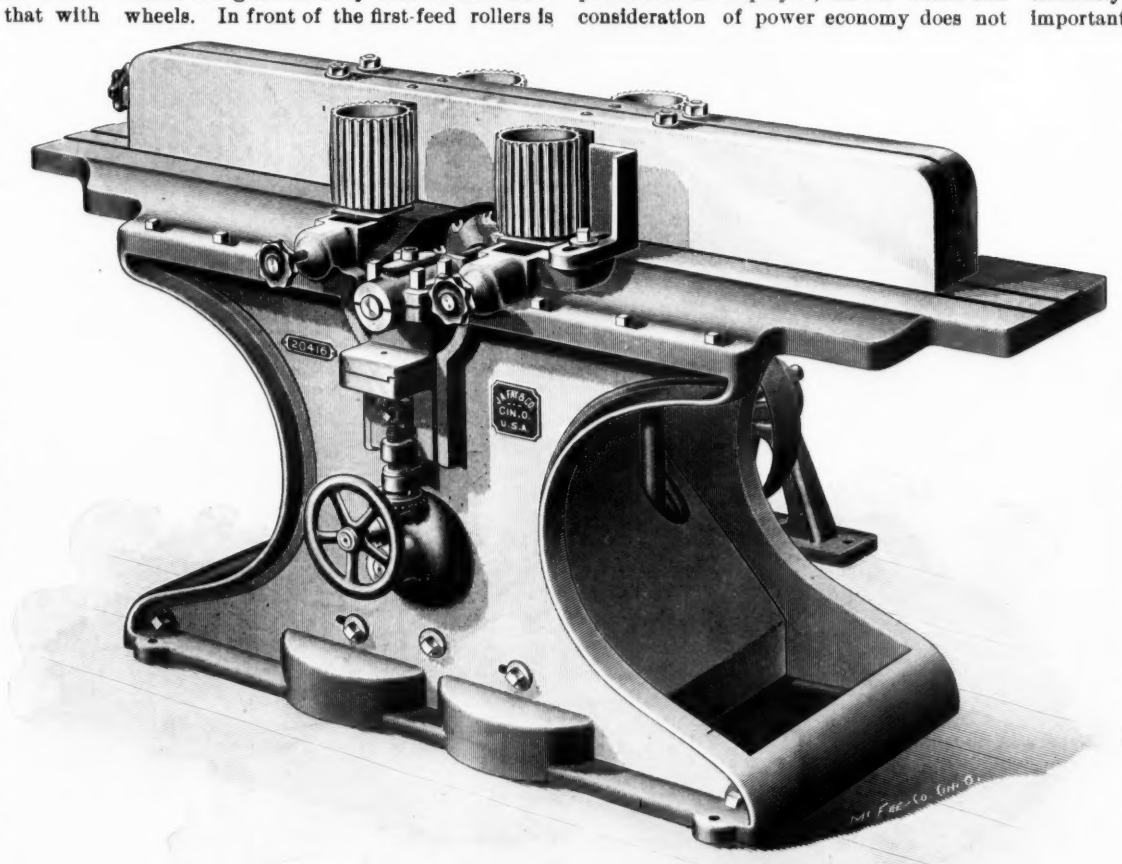
This attachment is also made to use split spring chucks with "drawing in" spindle, and will hold from ½ inch down to the smallest diameters.

The maker does not claim that this fixture will stand up to take a heavy cut with a large mill with coarse teeth, but that with properly adapted cutters and ordinary care it will be found very efficient, is simple in operation and easy to apply. It is made by Ernest F. Robbins, Burrville, Conn.

Vertical Feed, Power Matching Machine.

This is a substantial machine intended for tongueing and grooving short stuff for boxes, bottom boards for wagons, sheathing and work that is not parallel on its edges, nor of equal widths. The frame is made of plate sides and with large floor base. The matching works consist of an arbor made of best quality cast steel 1 9/16 inches in diameter, running in self-lubricating bearings of good length. The arbor carries either two matching heads or two sets of saws, one for tongueing, the other for grooving. These run below the platen on either side of an adjustable fence. The face of the feeding-in platen is lower than the feeding-out platen to accommodate the cut. The arbor is adjustable vertically to allow for wear or difference in the cut.

The feeding mechanism is very substantial, consisting of four feed rollers, driven by a train of heavy gearing at the base of the machine. Changes of feed can be made by simply changing the size of the feed pulley. The fences are adjusted to the heads by a wedge arrangement between them, moved by a screw which graduates their movement so the tongue and groove can be placed in any desired position on the material. There are two idler rolls in each of the fences to relieve the friction of the feeding rolls. The driven rollers are held against the material by strong, coiled springs which are graduated by screws and hand wheels. In front of the first-feed rollers is placed a small stand to prevent a piece of material being crowded beside one that is passing through.



MATCHING MACHINE.

The machine is made by J. A. Fay & Co., Cincinnati, O.

What Has Economy To Do With Compressed Air?

BY FRANK RICHARDS.

While we are considering the economy in the use of compressed air as a means of power transmission, it may not be amiss to think of the many purposes for which compressed air is employed, and to which this consideration of power economy does not apply. We may say, indeed, that in a large majority of cases in which compressed air is used the question of power economy does not apply. Even in the use of compressed air for driving rock drills, the field which still probably employs one-half of all the compresssed air that is used, the question of economy, or the comparative cost of operation, so far as it bears upon the employment or rejection of the system, is not worth considering, because in this field compressed air has no competitor, unless hand power may be said to be one. In the use of compressed air for operating the brakes upon railway trains, a service which employs more air compressors than any other line of service in the world, the economy of power in the use of the air for the purpose has nothing to do with the case. Though the compressors employed for this service use double the steam that they should use for the work that they do, and double as much steam as the best designed compressors would use for the same work, there would be no thought of throwing the air brake off the trains, if those "compressing pumps" used double or four times as much steam to do their work as they use now. The cases are few in which compressed air is employed merely as a means of power transmission and in competition with other means of power transmission, meeting them upon equal terms, and with no consideration but that of the comparative economy with which the power is transmitted. There are many cases that are clearly cases of power transmission, or cases of work to be done at a distance from the source of power, where the question as to whether the power is to be applied continuously or intermittently may be a most important factor in the general problem.

Compressed air is unique among all power transmitters, in that it is always and instantly ready to do its work to its full capacity, and yet it charges nothing for its services, except when it is actually employed. Others may or may not propose to do the actual work a little cheaper, but they expect to be an expense for maintenance all the while. A single air-compressing plant is capable of operating the switches and signals upon a section of railway 20 miles long, and when the pipes are once filled with the compressed air that air does not condense or suffer loss or deteriorate in any way, except as it is used. Electricity makes open confession of its inability to do this intermittent work, in that while in the switch and signal service it is actually employed to give the wink to the air as to what is wanted, the air does the work. It need not be said that steam could not do this work, for its strength would all be turned to water before the end of the pipe was reached.

The "compressing pump" of the air brake service being familiar to all railroad men, and being at hand or easily procurable by railroad shops, has been always ready in those shops with its supply of compressed air, and this ready supply of compressed air has led to the general employment of it in railroad shops and in railroad service for a variety of uses. Whatever it is tried for,

its use for that purpose continues, and one thing leads to another. These uses of compressed air in railroad shops continually increase, and the volume of air used increases, and the increasing demand for air is met by setting up additional compressing pumps in succession, until, in some instances, as many as eight of them have been employed together to supply a single shop. It is evident here that power economy could have little to do with the case or some thought would be given to the economical compression of the air, and a good air compressor would take the place of the air-brake pumps as a means of supply.

A recent paragraph tells how a master mechanic does his whitewashing by compressed air: "An old freight car has been fitted with three air-brake pumps and two reservoirs," instead of one air compressor and reservoir, "the pumps being driven by steam from an engine (locomotive) and a pressure of 40 pounds being maintained in the reservoirs. The car and engine are run upon the track alongside the building to be whitewashed. By a system of piping the air is carried into the building, and to the long iron nozzles used by the men in applying the fluid. Each man has an iron tube with a funnel-shaped end, from which the whitewash is sprayed upon the woodwork. To each nozzle are attached two lines of hose, one supplying the air and the other the whitewash. The air rushes into the cylinder of the nozzle and its pressure causes a suction that brings up a stream of whitewash and at the same time expels it in the form of spray." There can be no doubt of the success of this scheme, but if it pays to use a locomotive and three brake pumps, and all the rest of it, for such a job there must be economy in compressed air if economically compressed.

The progress in the use of compressed air thus far seems plainly to indicate that its wider application is promoted more by having a supply of it ready at hand or easy to get than by showing how cheaply the air may be furnished. Those who are introducing small, cheap compressors that work with reasonable economy are doing excellent missionary work for compressed air. Further along, as large permanent plants are established, we may believe that the minutest economies will receive the consideration that they deserve.

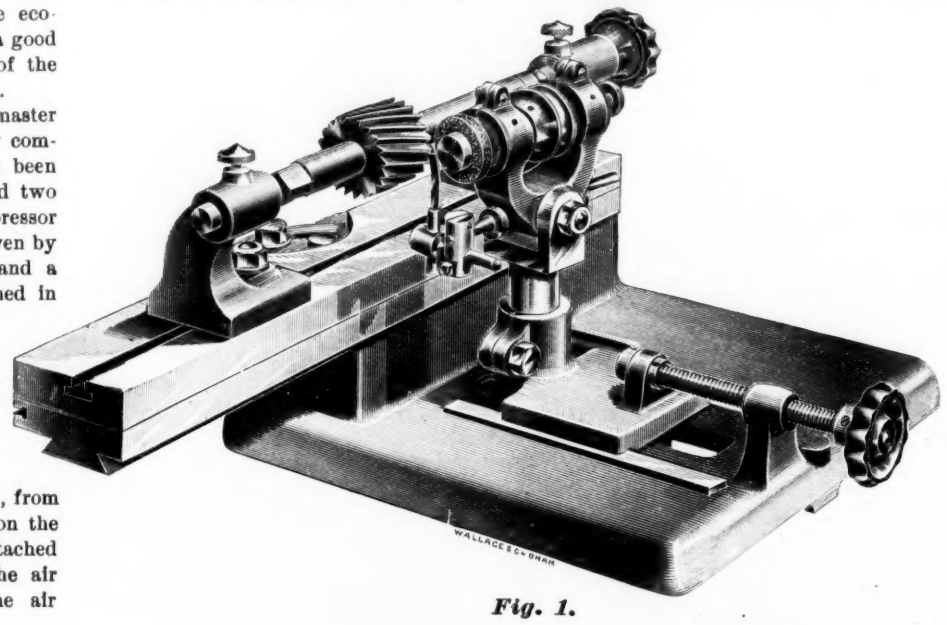


Fig. 1.

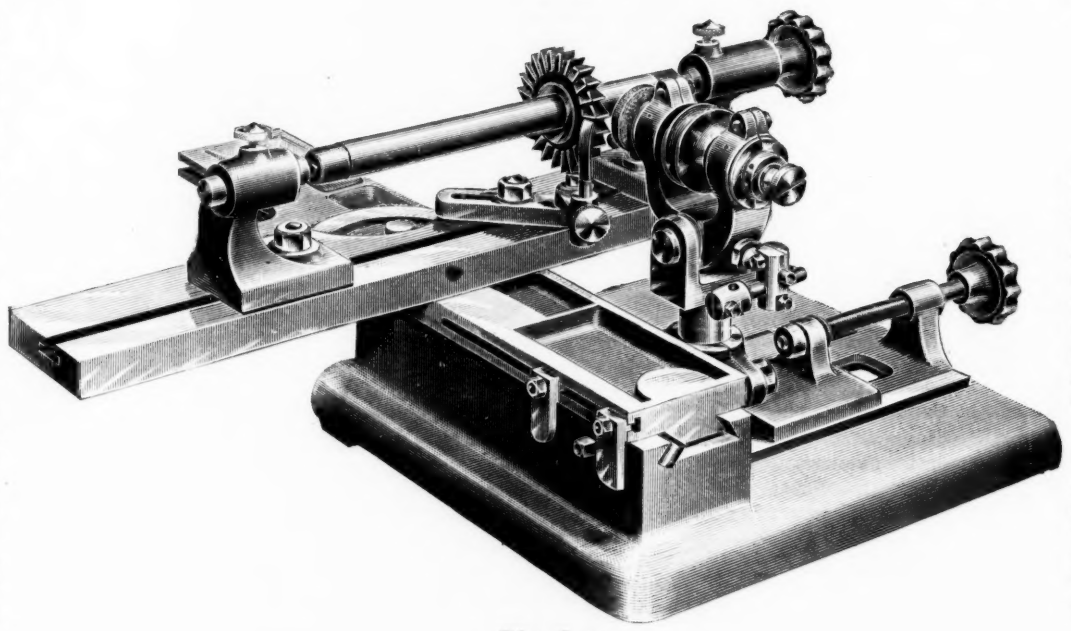


Fig. 2.

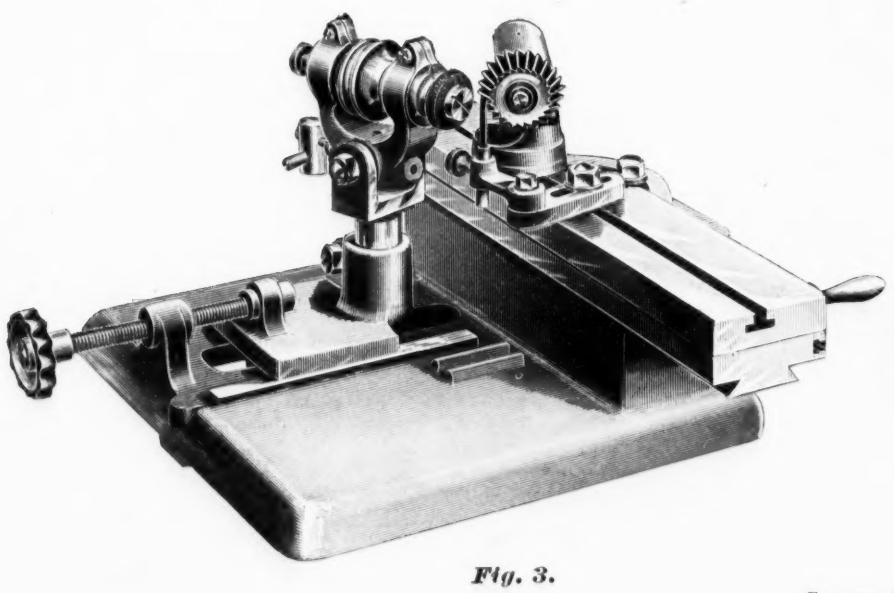


Fig. 3.

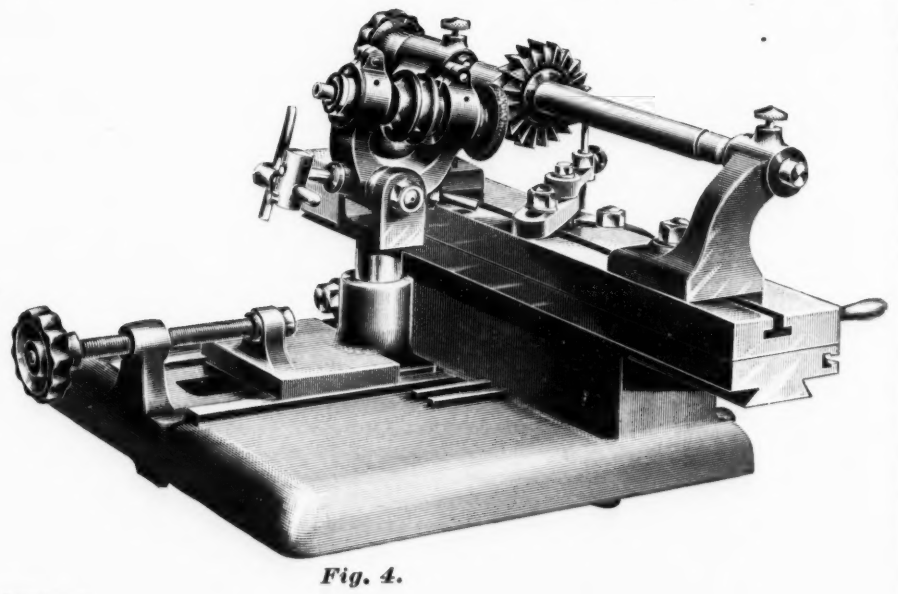


Fig. 4.

CUTTER GRINDER.

Cutter Grinder.

We give on this page four views of a cutter-grinding machine of somewhat novel construction, the product of an English tool builder—Alfred Herbert, Coventry, England.

The machine is in reality mounted upon a round column which carries a shelf, but to economize space this column has been left out in engravings. As shown in Fig. 1, the machine is seen to consist essentially of a slide carrying centers between which the work is held, while a slide at right angles to this carries the spindle head. The centers can be set at any required angle to the slide upon which they are mounted for grinding tapered cutters or the radial teeth of cutters, and such cutters as shown in Fig. 1 can, if desired, be arranged to slide upon the arbor in passing the wheel, this, in our opinion, being the preferable practice. One of the centers is provided with a spring, which facilitates putting in and removing the work.

The head carrying the wheel spindle is moved by a slide to or from the centers and is universal, being adjustable vertically, and also swiveling in horizontal and vertical planes, as shown in other views.

The wheel spindle is of steel, hardened and ground, and runs in dust-proof ball bearings. Wheels can be placed upon either end of this spindle, and can be presented to the work in almost any manner. Fig. 2 shows the arrangement for grinding the radial teeth of a cutter; Fig. 3 an angular cutter, using in this case a universal head which forms part of the machine, and Fig. 4 using a dished or cup wheel to give a straight clearance. In this last instance, a hooked tooth rest is used upon the side of the cutter opposite the wheel.

Special spindles or holders of various forms can readily be fitted to the universal head for holding taper shank or other forms of cutters. The largest cutter that can be swung upon the centers is 7½ inches; distance between centers, 18 inches; travel of table, 10 inches.

Hartford, Conn., is proud in possessing the largest and most powerful locomotive steam fire engine in the world. Over 10 feet high and 17 feet long, it weighs 8½ tons, and can throw 1,350 gallons of water per minute. The boiler contains 301 copper tubes. This engine at her first trial threw, through fifty feet of hose, 3½ inches in diameter, a horizontal stream of water a distance of 348 feet and threw two streams, each as large as that thrown by an ordinary fire engine, a distance of over 300 feet. The road-driving power of the engine is applied through two endless chains running over sprocket wheels on each of the main rear wheels, permitting these wheels to be driven at varying speeds when turning corners. The engine may be run either forward or backward and can be stopped inside of fifty feet when running at full speed. When in the house the boiler is connected with steam pipes from a heater in the basement and steam is always kept up to about ninety-five pounds, which would run her about a quarter of a mile. The fire-box is kept full of material ready for lighting, and a steel arm under the engine carries a quantity of waste saturated with kerosene; in close proximity to a card of matches in a holder under a scratcher, the latter being attached to a ring in the floor. At an alarm of fire the steam pipes are disconnected, the throttle opened, and before the engine has moved six inches, the cord pulls the scratcher and the rod carrying the blazing waste swings around under the fire-box, igniting the shavings and wood. Cannel coal is burned and steam enough can be generated in two minutes to run the engine at a speed of 31 miles an hour.—*The Fireman's Herald.*

An Inspector's Strange Experience.

An inspector in our northwestern department writes to us concerning an experience that recently befell him, as follows: "I had an experience a few weeks ago, which I should be quite reluctant to repeat under the same circumstances, if it could be avoided as well as not. I called to make an inspection at a stone works here, where they have two boilers, but use only one at a time. The engineer was working at his two pumps, which he could not get to throw water, and was scolding because he had no steam to run with, although he had had plenty only a short time before. The tubes in the boiler I was going to inspect were badly choked, and, in fact, nearly filled with soot from the coal. I thought that might be the trouble with the boiler they were using, so I opened the front of that boiler and looked into the tubes. *They were red hot* I looked for the water. It was gone. I looked under the boiler to see the fire, and *jets of burning gas* were actually spurting out between the rivets on the seams over the fire. And the engineer was still working at his pumps, trying to get some water. I had a queer feeling just at that instant. I got the engineer away from the pumps as

soon as possible and had him draw the fire; and I could see the gas burning along the seam while the fire was being drawn. As soon as it was darkened in the arch a little, I could see that the sheet on the bottom of the boiler was red hot for a space about three feet square. As soon as the boiler cooled down we opened the manhole, and found the inside to be bone dry. The outcome was that the seam next to the bridge wall was badly fire-cracked and sprung, so that a new sheet had to be put in. The tubes all had to come out, and all the seams on the fire surface had to be re-calked; which I consider to be a very fortunate escape."

We have no comment to make upon this report, at present, beyond the statement that the inspector in question is a thoroughly honest and competent man.—*The Locomotive.*

On the Cultivation of the Inventive Capacity by the Solution of Constructive Problems.

BY LEICESTER ALLEN.

I have received a considerable number of solutions to problems Nos. 6 and 7, printed May 3d, and will now present some of these solutions. The first one I will present has been contributed by Mr. J. T. Slocomb, of Providence, R. I., who has greatly contributed to the interest that has been manifested in these problems from the outset. The following is a description of his device which is illustrated in Figs. 1 and 2.

A and *B* are intended to have teeth, and the same letters in each view represent the same parts. The support *C* shown in Fig. 1 is removed in Fig. 2, so as to more clearly show the arrangement of parts. The support *C* is an arm keyed to the spindle carrying the ratchet wheel *D;* and at its outer extremity is a pivot *G* upon which rocks the bent lever *H*. This lever is connected at its opposite extremity to the pawl lever *E* by a slide-block arrangement shown at *F*, which works in a slot *I* in the lever *H* the block being pivoted to the pawl lever *E*, as shown at *K*. When the lever *E*, which works upon the spindle *L*, is rocked upon the spindle it performs two functions; it moves the ratchet wheel in the direction shown by the arrow in Fig. 2, the pawl *M* then engaging in the teeth of the ratchet; at the same time it causes the sector arm *M* to move in the direction indicated by the arrow placed near its pawl *M'*, causing this pawl to pass over twice the number of teeth that it would pass over by virtue of its motion relatively to the spindle *L*. When the action of the lever *E* is reversed, the pawl *M'*, having engaged the teeth of the ratchet, moves the wheel through an arc corresponding to half the number of teeth it has just passed over, and hence moves the wheel through the same arc that it was moved by the pawl *M* during the previous motion of the lever *E*. It is, of course, to be understood that the distances between the centers *G* and *L L* and *O*, and the radii *P P'* must be so proportioned as to give to the pawl *M'*, at its point, the same motion during the reverse movement that the point of the pawl has during the initial movement.

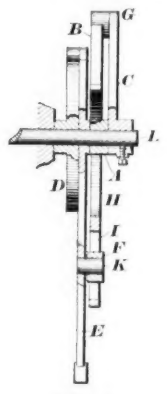


Fig. 1

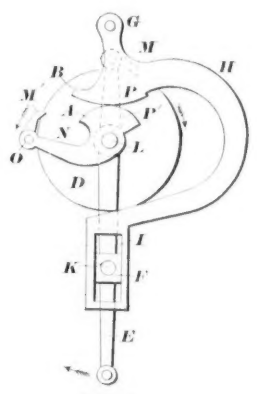


Fig. 2

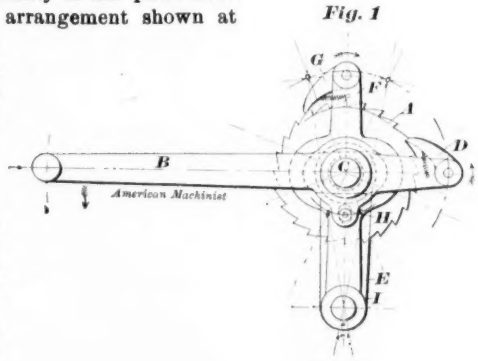


Fig. 5

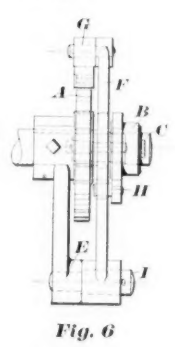


Fig. 6

This movement completely solves problem No. 7, as announced. Of course, I did not intend such a refinement of the movement as would exclude any little variation between the arc described by the initial rock lever, and the arc described by the ratchet wheel resulting from backlash; and I make this remark now in advance for other solutions that will be presented. Mr. Slocomb's movement can be made as strong as may be desired, and in every way admits of good mechanical construction. However, I think it has been anticipated, and that it already exists in some mechanism which, at present, I cannot call to mind definitely. If any one can point out where it is now in use, I shall be glad to have it made known. Mr. Slocomb has also contributed a solution to problem No. 6, the consideration of which I defer for the present.

The next solution I will present has been sent in by Mr. H. D. Penney, of Chelsea, Mass. In this solution Mr. Penney has adopted the same principle that I used in solving the problem before giving it out; but his method of treatment varies somewhat from that which I used. His movement is illustrated in Fig. 3. His description is as follows:

In the figure *p* is the given ratchet wheel actuated by the lever *b* and pawl *e*, as given in the problem. On the stud *h* in front of the ratchet wheel is placed the disk *f* which is fast to the stud and does not turn. This disk contains a radial slot *g* in which the block *c* is free to slide back and forth, and is connected to the lever *b* by the link *d*. The arm *a* is free to vibrate on the stud, and is connected to the block *c* by the link *d'*, and carries a pawl *e* at its outer end. As the lever *b* vibrates, motion is communicated to the block *c* by means of the link *d*, which slides back and forth in its slot, which, in turn, communicates its motion through the link *d* to the lever *a*. The levers *a* and *b*, and the links *d* and *d'* being alike, the motion of the arm *a* is equal to that of the arm *b*, but in an opposite direction; therefore one pawl drives the ratchet forward while the other is making the return stroke, and through an equal arc.

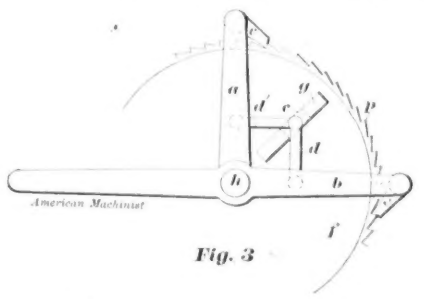


Fig. 3

Mr. Penney's solution is capable of a good, strong and durable mechanical design and every way meets the requirements of the problem. I will now, in Fig 4, present my own solution referred to in my article of May 3d. Not that I deem it any better than either of those already presented, nor than others yet to be presented. But as its study was the origin of the problem, and as its details vary somewhat, it may be of interest. The history of this movement is as follows: I was designing a machine or register which required that each register wheel should move in opposite directions of the movement of a rocker arm *L*, in the figure, that is to say, when the lever moved from *A* to *B* the ratchet wheel *W* should move in the direction indicated by the arrow. To accomplish this result I employed the bent arm *L L'* and the linkage system *K K' K'' K'''*. The bent arm was fitted to turn on the spindle around the center *C*, and the link *K* was sleeved on the hub of the lever. The links *K' K''* were respectively pivoted to the outer extremities of *K* and *L'*, and also to the lower end of the link *K'''*. This link was pivoted at the upper end to a fixed support *M*, carried by the spindle, and

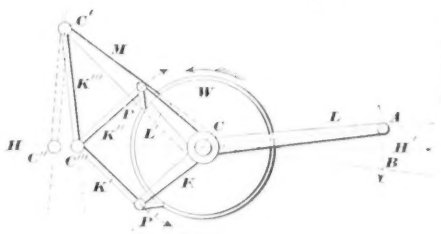


Fig. 4

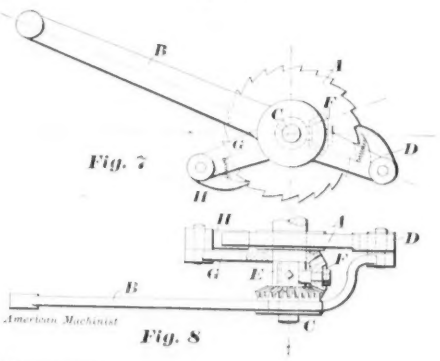


Fig. 7

Fig. 8

INVENTIVE PROBLEMS.

be placed at *P* the movement of the ratchet wheel will take place during the upward movement of *L*, and if placed at *P'* the movement of the wheel will take place during the downward movement of *L*. If a pawl be placed at each of the positions *P* and *P'*, both pawls pointing in the direction shown, the wheel will turn in the same direction, and through equal arcs both in the upward and downward movements of *L*. If the pawls be arranged to point in opposite directions the wheel *W* will simply be turned in opposite directions during the upward and downward movement of the arm *L*. If the pawls be reversed so as to point in a direction opposite to that shown in the figure the wheel will be turned in the opposite direction to that indicated by the arrow in the figure, and through equal arcs, during both the downward and upward motions of *L*. The pawls may be made to engage the ratchet teeth either by balancing them so that gravity will hold them to their work, or springs may be used.

Mr. William A. Morse, of Yonkers, N. Y., writes that he has been greatly interested in the solutions of the constructive problems presented in the AMERICAN MACHINIST, and has sent in three excellent solutions to problem No. 7. The first of these is illustrated in Figs. 5 and 6, being respectively a side view and an end view of the device. I quote from Mr. Morse's letter the description of his several solutions:

"In Figs. 5 and 6 the given parts are indicated as in the problem, *E* is an arm keyed to the shaft *C* in the rear of the ratchet. *F* is a lever pivoted upon the stud *I* in the arm *E;* *H* is a cam roll upon a stud in an extension upon *B*, and engages in a slot in *F*. *D* and *G* are pawls engaging the teeth of the ratchet.

"As the long end of *B* is moved in the direction of the arrow, the wheel will be rotated to the left by the pawl *D*, while the lever *F* moves to the right dragging the pawl *G*.

"When the lever *B* is moved in the opposite direction the pawl *D* will drag, while *G* will engage the teeth and rotate the wheel to the left, moving through equal arcs for both movements of *B*. This is shown by the dotted lines."

The second solution contributed by Mr. Morse, is shown in Figs. 7 and 8. Here the added parts are as follows:

G is a pawl arm loose upon the shaft *C*, and having a bevel-gear segment upon the hub; a bevel gear of equal pitch diameter is placed upon the hub of *B*. *F* is an intermediate bevel pinion pivoted on a stud in the collar *E* which is keyed to the shaft.

It will be obvious that when *B* is swung in either direction the ratchet will be rotated constantly to the left, and will move through equal arcs for either direction of *B*.

With reference to the third solution sent in by Mr. Morse, he states that it was suggested to him by another gentleman with the request that he (Mr. Morse) would send it in with the two already given. The device is illustrated in Figs. 9 and 10, respectively a plan and elevation.

The given parts are designated as in the previous figures. *G* is an arm loose upon the shaft *C* carrying the pawl *H*. *E* is a slotted piece fast to the shaft and *F* is a block free to slide in the slot, being held in place by tongues and grooves.

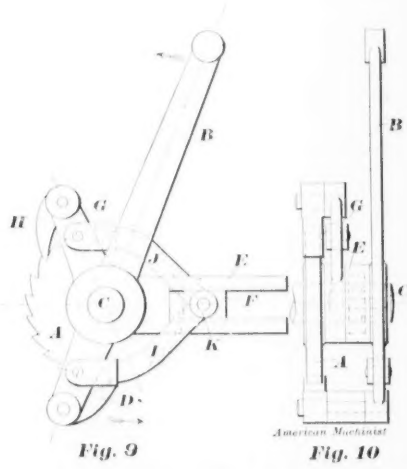


Fig. 9

Fig. 10

I and *J* are links forked at one end and jointed to the pawl arms. The other ends are jointed to the block *F* upon the pin *K*, *K* being solid in *F*.

When *B* is moved in the direction of the arrow, the pawl *D* will rotate the wheel to the left. The block *F* will be pushed by the link *I*, and will pull *J* and *G*, dragging the pawl *H*. When *B* is moved in an opposite direction, *H* will rotate the wheel and *D* will drag, the motion of the wheel being always in one direction and through equal arcs.

This very interesting solution corresponds in principle so closely with that given by Mr. Penney that they may be considered substantially identical. It is profitable, however, to consider the various ways in which a mechanical principle may be applied.

A very unique solution has been contributed by Mr. James C. Dawley, Jr., of Springfield, Ohio. This is shown in Figs. 11 and 12 and appears to satisfy fully the conditions of the problem. In this solution the principle of linkages is employed, but in different manner from any other solution yet received. With reference to this solution, Mr. Dawley writes as follows:

"My method of obtaining the desired result, namely, the rotation of the wheel *A* in the direction of the arrow for both the up and the down motion of the lever *B*, is to make the link *a* fast to the shaft *C*, the link

d being free to rotate about the shaft C, and the link b pivotally connected to the link a. At the extremities of b and c is a roller e which works on the double incline f. When the lever B is moved down, the pawl

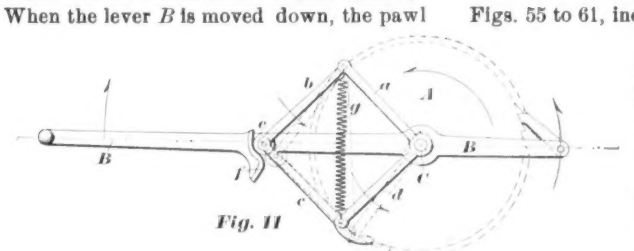


Fig. 11

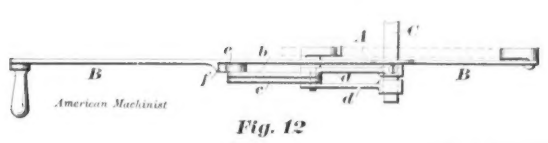


Fig. 12

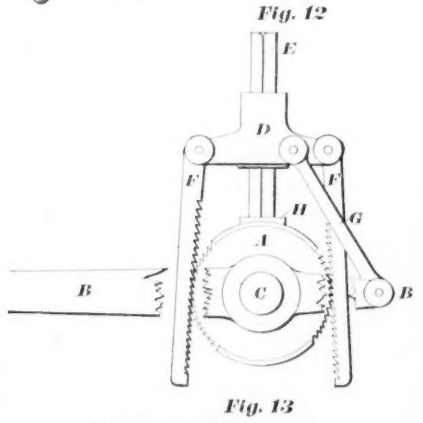


Fig. 13

INVENTIVE PROBLEMS.

at the right of B rotates the wheel A in the direction of the arrow, the links a b c and d remaining in the position shown by the full lines. When the lever is moved up, the incline f comes in contact with the roller e and forces it to the dotted position, thereby rotating A in the direction of the arrow. Immediately after the incline leaves the roller, the spring g pulls the links to their full line position again. Upon the down motion of the lever B, the lower portion of the incline f will again come in contact with the roller e and move the links to the dotted position and rotate the wheel A at the same time the pawl on the right of B comes into operation."

Mr. L. C. Sharp, of the Omaha Electrical Mfg. Co., writes that he is very much interested in these problems, and hopes they will be continued. I beg to thank this gentleman for the encouragement contained in his letter, and also for the solution to Problem No. 7 which he has contributed, with which I will conclude the present article and which is presented in Fig. 13. Mr. Sharp describes his device as follows:

"In this solution the crosshead D moves up and down on the slide E, and the arms F F engage alternately in the teeth of the ratchet wheel A, one arm pushing the wheel and the other pulling it. The slide E may be rigidly attached to the shaft C. You may observe that the arms F F spread out a little at the bottom. I have arranged it thus so that they will always have a tendency to hug the ratchet wheel closely. For heavy duty, I presume, I should attach a heavy spring between the arms to hold them down to work. I should, of course, then expect considerable noise by kicking."

I find that the answers to Problem No. 6 will require more consideration before presenting them than I have yet found it convenient to bestow upon them. They will receive attention in a future number.

A force of one pound moving at the rate of one mile in one minute equals .16 horse power.

Machine Shop Milling Practice.—X.

By Horace L. Arnold.

Figs. 55 to 61, inclusive, show the Brown & Sharpe pillar milling machine No. 24, Lipe's patent. This machine weighs about 3,950 pounds only, and takes a floor space 52x103 inches, is driven by a 4-inch belt on a 3-speed cone, the largest step of cone being only 11 inches diameter; the cone is on a worm shaft and drives the spindle through a worm gear only 6 inches diameter with 40 teeth, and the cone and worm shaft is extended through the head stock and carries a friction disk which drives the feed, 1¾ inches per minute, maximum, at 22 revolutions of mill spindle, which was the speed used when the cut shown in Fig. 60 was made. The out-board end of the spindle is supported by the overhead sliding arm, and also by the extremely light and seemingly wholly inadequate double diagonal brace, friction-held by bolts and washers in adjusting slots, as shown in Figs. 55, 56 and 58. Small and unsubstantial as this brace appears to be it is so effective as to support the spindle with what was, so far as could be judged from careful inspection at work, perfect efficiency under the strain of the 9-inch cut shown in Figs 56 and 60, which were photographed for this article.

This Brown & Sharpe "Lipe" machine is a most interesting example both because of its surprising efficiency per pound of total weight, and its wide divergence from common practice in the out-board mill spindle support, and because the means for driving the spindle seem very much too small and unsubstantial for such cuts as the machine takes with perfect ease. This machine has also an extremely interesting "personal" history, as detailed to me by Mr. Viall, to whose notice it was brought by those who were very favorably impressed by its performance while in the shops of its inventor, Mr. Lipe, of Syracuse, N. Y. After repeated solicitations Mr. Viall finally went to Syracuse and saw the machine, and was very unfavorably impressed with the worm drive; the machine, however, embodied a number of details which met Mr. Vial's approval, and to secure these details, many of which were not covered by patents, Mr. Viall advised the purchase of the patent by the Brown & Sharpe Co. Two or three of the machines were built and sent out with the worm drive, and in Mr. Viall's own words, "tore themselves all to pieces," and had to have the worms and worm gears changed in tooth shape; at this time Mr. Viall was strongly opposed to the use of a worm drive. In order, however, to save an entire rebuild of these machines, experiments were instituted to find a suitable worm and worm gear tooth, resulting in such a degree of success that Mr. Viall is now one of the most pronounced advocates of worm-driven mill spindles; and, indeed, such evidence of the great effectiveness of worm-driving is in my possession from widely different sources as to warrant the statement that the spiral or "worm" drive is *probably* superior to any other for mill spindles.

It would seem impossible that the thin, light casting which forms the out end support of the mill arbor in these machines, should prove at all adequate to its work. The eye is so accustomed to substantial knees and foot stocks in this place, that the thin, long friction-held brace shown in use in the accompanying illustrations has the

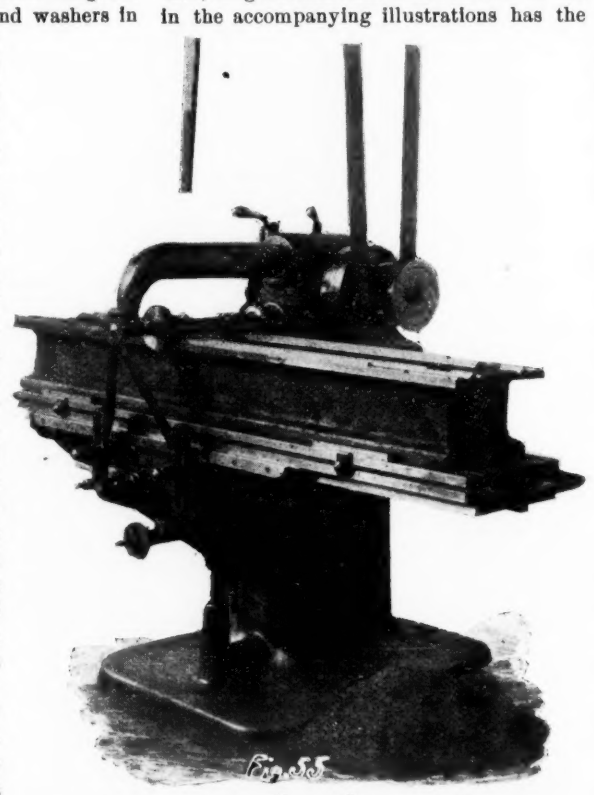


Fig. 55

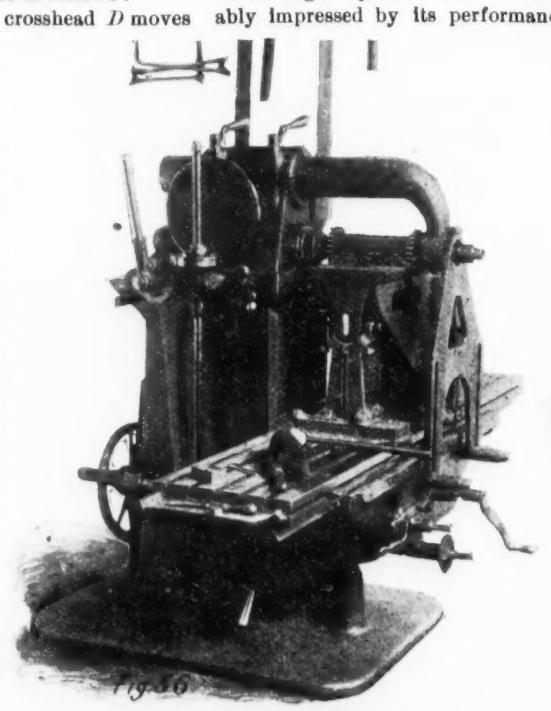


Fig. 56

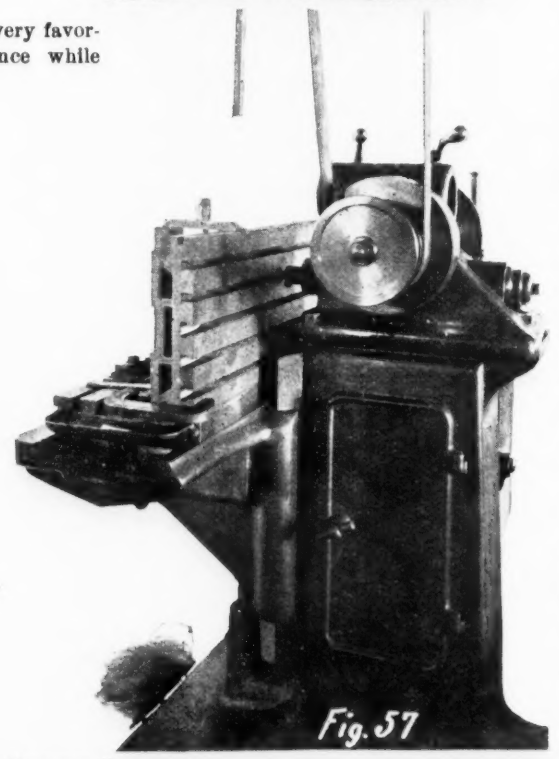


Fig. 57

MACHINE SHOP MILLING PRACTICE.

9 inches in width with the work fed against the revolution of the mill, must be held down to its work; and until I saw this machine actually making a heavy surface cut I did not believe the mill spindle was so supported by the out end brace as to be capable of any performance approaching what it really can do with perfect ease and steadiness. No difference how heavy an overhead round arm with a down-hanging end to support a mill arbor may be made, it yields very easily through a small arc of vibration, and does not give the absolute certainty of unvarying mill position which is needed to force the teeth of a mill to sink into the solid body of the metal cut, as they must be forced to make them cut at all; and while the overhead arm is far better than no support for the out end of the mill spindle, it also falls far short of an ideal abutment to resist the separating influence of small angle metallic wedges driven between a plane and a cylinder, which is what a mill arbor support really has to resist, and, in fact, no overhead arm can, alone, possibly afford the rigidity needed for this office. It is true that beyond a very small movement the overhead arm is stiff, and offers great resistance to additional distortion. Hence, if a mill cut offered a uniform resistance the arm would yield until it did support the cut, and thereafter, during the progress of the cut the position of the supporting arm would remain unchanged. But the actual resistance of the mill cut varies continually; the teeth do not cut alike, and in the first heavy cut on cast-iron there is almost always a considerable difference in the depth of cut or thickness of metal removed, so the down-hanging end of the sliding arm mill support is often seen in a state of constant vibration while the mill is cutting. The angular divergence of the legs of the thin brace used on the Brown & Sharpe No. 24 puts one of its members in tension and the other in compression when at work, and to this fact the efficiency of this brace is probably due. It is a very convenient and readily adjusted device; and it is certainly effective to a degree which seems to leave nothing to be desired.

Still, granting a perfect support to the outer end of the mill spindle, it does not seem possible that this small machine, with its little 6 inch worm gear for a spindle-driver and with the work supported on an angle plate at a height of 18 inches above the work table, and the work table in its turn supported only by an overhung knee was in any form to have a mill cut nine inches in width with two edging cuts about ¾ of an inch wide, making about 10½ inches actual width of cut from ⅛ to ¼ inch deep removed from its surface at one operation; yet it does take this cut with perfect ease and steadiness with a feed of 1¾ inches per minute. When I first saw this cut, as shown in Fig. 56, the feed was very slow—about ⅝ inch per minute. Comment on this was met by the remark that, "New England mechanics were very careful of tools." The foreman in charge was interviewed and stated that the feed was the greatest possible with that cut; the cut was too high up off the table and too wide to permit greater feed. A suggestion as to the possibility of greater feed was met by the assertion that it had been tried and that the belt refused to pull it. Finally, with great reluctance on the part of the workman, who honestly expected disaster of some sort, the feed was increased a little at a time from the original ⅝ inch per minute to the extreme feed possible, 1¾ inches per minute with 22 revolutions of spindle; and with the result of better work and seemingly *less* pull on the belt than when the cut was made with a feed of ⅝ inch per minute. After having the explanation that the mill was making the same number of cuts per minute no matter what the feed was, or in other words, that, given a constant depth of cut and speed of mill the area of metal sheared by the mill teeth is constant, no matter what the feed is, and that the fast feed gave thickness of chip enough to aid in holding the mill teeth in work. The brow of the workman cleared up somewhat, and his apprehensions of dis-

aster seemed mitigated. Some remarks were made by the foreman's foreman in regard to the difference between the production of cast iron meal and the production of cast-iron chips, and the cuts proceeded at a time ratio of 14 to 5 as compared with that previous to this episode. The foreman in charge of the machine was perfectly honest; his *own view* of his own experience made him certain that the belt would not drive the machine at all with the increased feed. He smiled a pitying smile as he put the feed up, evidently expecting the driving belt to leave the worm pulley with each increase. It had never entered his head that a fast feed cut just the same surface of metal as a slow feed in the same work, no more and no less; and many persons seem not to understand *clearly* that it takes power to cut iron, and hence the smaller the chips the greater the power required to cut a given weight of iron into those chips; nor that a heavy cut or an increased chip thickness may, under certain conditions, be actually easier on the driving belt than a light cut. So far as could be judged from this particular experiment, the belt did drive the machine easiest with the fastest feed. The machine was stopped in the midst of its work in the thickest part of the cut, and the photograph reproduced in Fig. 60 taken without touching anything, to show the exact appearance of the chips, which, of course, tell most convincingly the efficiency of the machine. The flats of the mill teeth in Fig. 60 were chalked before photographing, and the chalk is very clearly shown in the reproduction, otherwise nothing whatever was touched. The length of the cutter is 9 inches between the straddle mills, or mills which cut down the edges of the piece; the long body of the gang of mills is in two pieces cut spiral right and left and joined in the middle, and the faces of the teeth are radial; the diameter is 3½ inches with 18 teeth; the straddle mills 4½ inches diameter with 24 teeth, the revolutions 22 per minute and the feed 1¾ inches, giving the following figures for the long cut:

Surface speed of mills, 20 feet per minute.

Feed per tooth, 0.00442″.

Feed per minute, 1.75″.

A glance at Fig. 60 shows at once that the teeth of the long mills are not only cut spiral right and left, so as to make a chevron or herring bone tooth line, thus avoiding any side thrust on the work if the thickness of cut is uniform, but that the mill teeth have also a circumferential spiral cut, precisely as if they were threaded with a quick pitch square thread, so that the operation of the mill is just the same as chipping with a cape chisel and flat chisel by hand. Although the whole width of cut is nine inches, there is, say, only about *one* inch of full cut taken at any one instant. Each line of teeth is cut into ten or eleven teeth by the square cornered spiral cut through the line of the teeth, so that the action of the mill is to attack the mass of metal little by little, and often. I did not see an ordinary spiral tooth mill cut in operation on one of these No. 24 machines, but, I have no doubt, that the particular form of mill tooth shown in Fig. 60 is the thing which enables this small machine to cover so great a surface at one cut. The resistance offered by the metal to mill rotation is manifestly many times greater with a plain spiral mill tooth than with this "threaded" mill tooth shown in Fig. 60, and this form of tooth would seem the most suitable for a wide mill cut, because the metal which is to form a chip is supported only at the bottom and at one end, instead of at the bottom and both ends, and so offers vastly less resistance to removal than with a plain spiral mill tooth which cuts a chip from the solid surface of the metal. This form of tooth is comparatively recent in the Brown & Sharpe practice, and was condemned by the experts before trial, because it is well known that the corners of mill teeth give way first, and hence are to be carefully avoided so far as the form of the cut will permit, and in all good milling practice *are* sedulously avoided, every care being taken to avoid corners and preserve lines of unbroken curves. Hence it is easy to see that a mill "improvement" which introduced, as in Fig. 60, somewhere about 360 tooth corners where *none* previously existed was a most idiotic disregard of thoroughly sound and well established practice, the reasoning was clear, and the deduction sure; one corner in a mill tooth cutting surface is bad, and to introduce hundreds of corners where *none* were needed was rank folly. The fact that the introduction of the multitude of corners reduced the work to be done, and the power needed to do the work, was not suffered to modify this condemnatory reasoning until after prolonged trial and pronounced success had shown that in this case, as in many others, the fault of yesterday may be the virtue of to-day, and that the breaking up of the long cut into a multitude of short cuts was the only correct idea.

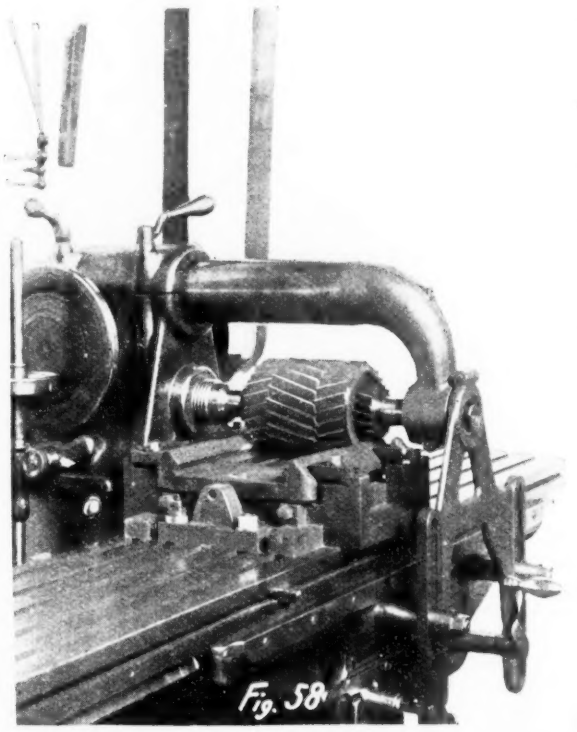


Fig. 58

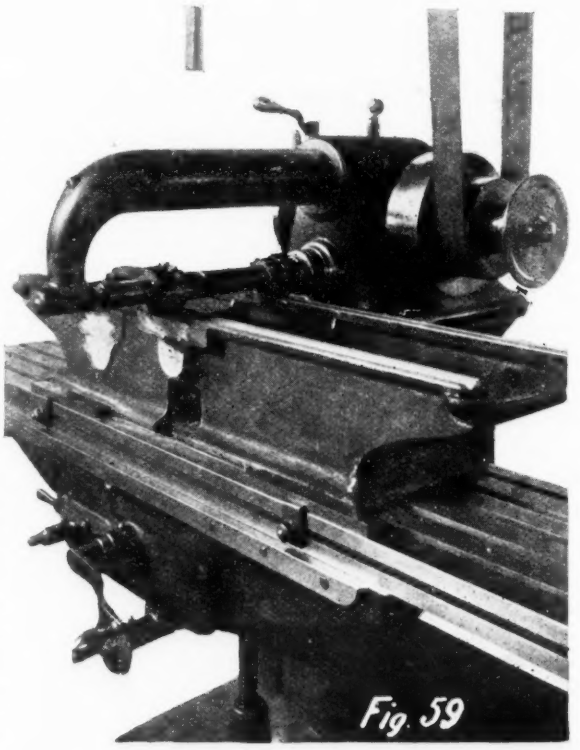


Fig. 59

Fig. 55 shows No. 24 in the act of milling a 13 inch engine lathe bed, 60 inches long, and gives a good idea of the great range and capacity of this little machine, and also brings the inadequate out end spindle support into prominent view, while the excellent quality of the work I saw produced shows clearly that the outer end of the mill spindle is in *fact* perfectly well supported.

In Fig. 57 the machine is shown milling out the T slots in a mate to its own table. Fig. 58 shows a comparatively small cut, and is given as showing in clear detail the general style and construction of a large class of fixtures for holding the work.

Until I saw this No. 24 at work on large surfaces, I supposed the pillar and knee type of milling machine suitable for small cuts only, and believed that some other form of machine must of necessity be used for wide surfaces, and I have many times heard it said by men of experience that the pillar and knee machine was convenient, and that was its only merit; that its form was such it could never be made rigid and non-vibratory to the extent demanded for good milling of large surfaces, and I have also often heard the opinion expressed that but for the fact that the Brown & Sharpe "universal" or tool maker's milling machine was a miracle of close fitting, the pillar milling machine would never have come into extensive use because of the general unfitness of its form. I have also seen work which could not be done at all in a *copy* of a Brown & Sharpe universal because of chatter and breaking of mill teeth, executed rapidly and well in a genuine Brown & Sharpe "universal;" I have also often heard the out-board brace for the mill arbor in these machines mentioned with contempt; and I am quite sure the spider-legged affair shown in Fig. 55 gives seemingly good ground for such poor opinion of its sufficiency. I have also heard the theory of "mass" in tool-framing advanced as a certain ground for the belief that the pillar and knee type could never have a large range of milling capacity; that its use must be confined to the tool room and small cuts in the machine shop; that were it ever so good in form, it simply lacked "mass" on one side, and must forever do its own little work in its own little way, and leave the broad field of general surface milling to tools of a radically different design. The reproductions of photographs taken for this article show conclusively that the "No. 24" will work on surfaces as large as it can present to the action of the mills, and that these surfaces are greater per pound of machine than can be had by using any double-pillar type of construction; the machines are light, the support for the mill arbor end is insignificant, the work table is far beyond a symmetrical proportion in its dimensions, and the mills are full of corners which make their speedy destruction certain, and the spindles are too light, and the machines are ridiculously under powered in the spindle drive—a mere 6 inch diameter worm gear on a mill spindle intended to do *work!* But the whole collection of blunders and errors makes a wonderfully successful and convenient machine when it comes to real downright hard continuous every-day machine shop milling on wide cast-iron cuts.

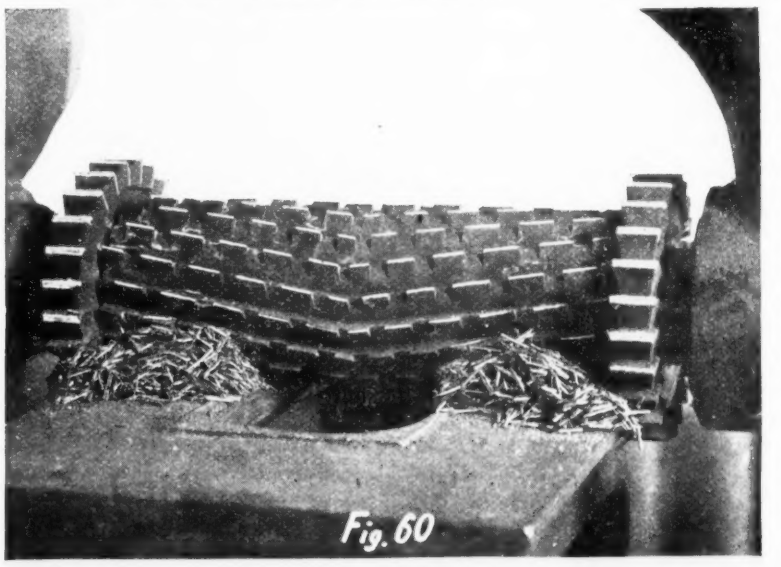


Fig. 60

"Keep's Test" is a Relative Test.

The matter given below was prepared by W. J. Keep, of Detroit, in relation to a discussion of his system of testing which took place at the recent meeting of the Foundrymen's Association. The limitations of our available space preclude the possibility of publishing the discussion in full, but as the matter given below, is in a sense supplementary to the first full and complete exposition of the system as presented by the author in our issues January 5, January 12, January 19, February 9, 1893, and June 7, 1894, we give it place. To give a better understanding of the matter, it may be well to explain that several chemists, assisted by some practical foundrymen, have taken part in the discussion, claiming that Keep's system is inadequate and that chemical analysis is necessary in order that the foundryman may be certain of knowing what his iron will do. Mr. Keep's position is that his system of testing, as practiced by him for several years in his own foundry, is sufficient for practical foundry use, and there are those who go further and declare that it is far better for actual use in the foundry than any other method.

The additional matter by Mr. Keep is as follows:

TABLE XIV. APPROXIMATE KEY FOR REGULATING FOUNDRY MIXTURES.

Size of the Casting.	Silicon Required in the Casting.	Shrinkage for the Best Castings.	Shrinkage of a ½ inch Test Bar.	Size of Test Bar "Keep's Test."
½ inch square	3 25 per cent.	.125 per foot.	.125 per foot.	½ inch square.
1 " "	2 75 " "	.125 " "	.135 " "	½ " "
2 " "	2 25 " "	.125 " "	.145 " "	½ " "
3 " "	1 75 " "	.125 " "	.155 " "	½ " "
4 " "	1 25 " "	.125 " "	.165 " "	½ " "

SERIES XV.

No. Test.	Change of Entire Iron Mixture and Coke in 4 Days Good Castings Each Day. 839 was a Little Hard.	Dead Load. Stren'th	Dead Load. Deflect'n	Shrinkage. ½ in. sq.	Shrinkage. Flat.	Chill.
837	Old iron mixture with Connellsville coke	417	.24	.129	.144	04
838	New iron mixture with Connellsville coke	407	.22	.148	.153	.07
839	New iron mixture with Pocahontas coke	377	.19	.158	160	.09
840	New iron mixture (silicon increased) Pocahontas coke.	419	.23	.141	.150	05
841	New iron mixture (silicon increased) Pocahontas coke.	423	.23	131	.146	.09
842	New iron mixture (silicon increased) Pocahontas coke	436	.23	.128	141	.04

The composition of cast-iron is so imperfectly understood that few realize that there is a direct relation between the shrinkage of a half-inch test bar, and that of the casting. I will illustrate the truth of this by table XIV. (continuing the numbers of my last paper), the figures of which are mostly taken from actual tests. To produce a uniform grain and a sound casting the silicon must vary with each variation in the size of the casting.

But such a variation in silicon will cause a relative variation in the shrinkage of a ½-inch square test bar. The table shows that a casting 1 inch square needs 2.75 per cent. of silicon to give it a shrinkage of .125, and that a ½-inch square test bar from the same metal will show a shrinkage of .135; but that a casting 4 inches square, on account of its slow cooling, needs only 1.25 per cent. of silicon to produce the same grain and shrinkage.

The .165 shrinkage of the ½-inch square test bar, shows that the iron will make a casting 4 inches square with a shrinkage of .125, and that it contains the correct amount of silicon.

The following experience, Series XV., during the present coal strike, is an illustration of the value of this relative test.

The mixture 837 was perfectly satisfactory, but owing to a stoppage in shipments of pig-iron a new mixture (838) was made. The shrinkage shows the need of more silicon, but as it was necessary next day to change to a coke which was claimed to be purer, the iron mixture was not changed for 839. Next day the silicon of the mixture was increased in 840, and a continuance of another day 841 brought the iron back to the standard. 842 shows that silicon must be slightly decreased next day.

LETTERS FROM PRACTICAL MEN.

Make Your Plans Known—Tried But Not Proven.

Editor American Machinist:

Mr. Lawrenz in one of your late issues called attention to a matter of a draftsman planning his drawings so as to help the patternmaker or machinist in laying out the work. I did not mean to criticise this matter, for I agree with him fully, but what I did mean to do, was to show the need of more originality in the work than is common. A method that may be good for a certain shape might not be near as good as many others, if the shape of that piece is changed but little.

Now, I have seen men who would lay out almost every job by the same method, and often the shape of the piece would show up the method to be rather shady. Now, a person who would lay out dimensions upon a surface plate, to be projected to the work with a square where the piece can be conveniently turned up at right angles, and the lines drawn with a surface gauge would be pushing a method out of place, but there are only two ways of knowing this; one is to think it out yourself, and the other to be told.

If a draftsman or anybody else plans out a method of doing his work that is out of the usual way, or that might not be understood, and he wishes for good reasons that this method be adopted, then he should make such plans known. A person who would design a casting without regard for convenience in molding, would be doing a rash thing, and if he has planned up any method in molding that is not likely to be readily seen from an examination of the pattern, then he should make this plan known.

A person who designs a piece and then makes it, will take advantage of forethought, will make the pattern as it was planned to be made; also use the machine tools that he had planned to use and had found out beforehand to be suitable, and there ought to be a better way than is common to convey ideas of this kind among men. No person should feel above going into the shop to find out if a certain piece will swing (that ought to swing) in any available lathe before going ahead too far, for there may be many other ways to shape it that will swing, and that will be equally satisfactory in other ways. This old saying: "There is more than one way to kill a cat," is just as true in mechanical things as anywhere else. This has been pretty well illustrated in the solutions of Mr. Allen's "Inventive Problems."

Some say there are many ways to do a thing, but only one *right* way. This depends a good deal upon what you consider right. To bring about the desired results in the cheapest way, is what most people would call right. Many will only plan on *desired results* and let *cheapest way* take care of itself. There is in most cases a pleasant combination of the two, if it can be found. They say that "cheap and nasty" go together, but this is not always the case. It is quite easy to make a cheap and nasty thing, but often quite difficult to make a cheap and good thing.

Mr. Lawrenz suggests a special machine for boring jigs, and as this is a favorite idea of mine, I wish to "put in an oar." Mr. McGregor promptly put his foot on the scheme, but I suppose he would remove it if he found that the thing could really "walk alone." It is often the case that a thing is tried and not proven. It is also often the case that a person will expect some of these ought to work plans to do the work without proper attention. A theory that calls for a true face plate, must have a true plate in order to make the practice agree with the theory, and it is often not sufficient to know that the plate is true before the work is clamped to it, but care must be exercised to see that the bolts used in clamping the work do not spring the plate out of true.

There are a hundred and one reasons why a person should keep his eyes wide open and his reason active, while he is working out practical theories. I should think a machine built on the general principles of a universal milling machine, with micrometer adjustments in all directions, and accurate steel scales and sliding plates, with lines to match, for the purpose of correcting errors in the screws, built and kept for the purpose of boring jigs and like purposes, in some shops, would be a profitable machine.

I have done considerable of such work on a regular milling machine, but as the machine was not intended for such work, and was not kept up as nice as the work required, it was hardly satisfactory. Such a machine would be a means of doing the work quicker, but I doubt that it would be the means of lessening the skill required to any great extent. A MECHANIC.

Removing a Crank Disk.

Editor American Machinist:

I have been a constant reader of the AMERICAN MACHINIST for four years, and have never attempted to criticise any of the statements that have appeared in it during that time, but there was an article in the issue of May 31st in regard to which I cannot resist the temptation to say a word. The article referred to describes a method of removing a shrunk on crank disk from a shaft.

After reading it through I thought it could not be that you would publish such a statement as a fact, and I read it through a second time to see if I could not discover something that would indicate that it was published as a sarcasm upon a class of writers who do not know "whereof they speak." But I was finally compelled to believe that it was published as a piece of genuine information. Now, as a practical mechanic, the method described seems to me to be absurd. If it were possible by some means to arrange matters so that the water would cool the shaft just to the joint, and *no farther*, and also that the fire would heat the disk just to the joint and *no farther*, then the thing might work. I do not know how many degrees of heat it would take to relieve a good tight shrink fit, but it must be quite a rise in temperature, and to expect that the extremes of heat and cold could be made to meet on the joint (or sufficiently near to be of any benefit towards relieving it) seems to me to be altogether out of the question.

St. Johnsbury, Vt. F. W. TAYLOR.

[The article referred to by Mr. Taylor was reprinted from our London contemporary, *Engineering*, and purports to give the actual experience of a mechanic who removed a crank disk which had been shrunk on by drilling a hole in the end of the shaft to run water through while the disk was heated by fire. We see nothing improbable in the matter, and think Mr. Taylor possibly attaches too much importance to a definite dividing line between the heated and the unheated portions of the work. We have no doubt that with ordinarily skillful management a shrunk crank disk can be removed in the manner described, for it seems to us clear that under the conditions the shaft will be much cooler than the disk, and that is the condition favoring removal. Perhaps some of our readers have had a similar experience.—ED.]

Tool Rooms.

Editor American Machinist:

In your issue of May 31st, I noticed a letter inviting correspondence on the above subject.

There is one in the D. & H. repair shops at Oneonta, N. Y.; it is a corner of one of the main shops, the size of which is about 20 feet by 25 feet on plan; the partition of scantling, covered with matched boards, is 5 feet high, and an additional height of 3 feet made of ½ inch gas pipe pickets.

It is equipped with milling machine, lathe, bench drill, two emery-wheel grinders and a twist-drill grinder, also bench and two vises,

Three men are employed there—the toolmaker, lathe hand, and one whose duty it is to give out or receive all tools that may be required by the floor men or others.

Convenient cupboards and shelves are arranged to keep the different taps, reamers, screw dies, etc. In fact, "a place for everything and everything in its place," even to a nice array of greenhouse plants in the two windows. The toolmaker sees that the full equipment of tools are maintained and in good order, and makes others for experimental work. There are two oil tanks placed there which hold a barrel of oil each, and all the men have to have their supply from "Jack."

The door is locked during working hours, so that no one can go in that has no business, and there are two "slides" cut in partition for communication.

Water and steam is laid on for lavatory convenience.

There are several gangs of men employed for the different kinds of repairing necessary, and their foremen have a supply of tools put in their care. These are not taken to the tool room, but stored when not in use elsewhere.

All files are kept in the general foreman's office, and given out by him or his assistant.

"Waste" is kept in the oil room, and every Saturday each man's supply is weighed out and distributed by a man detailed for the purpose.

In the above shops, the head of each department is furnished with an order blank, and all material, etc., from the stores or other department that may be required must be specified, as follows:

Date.....1894

Ordered by.....

Charge to.....

Material.....

.....

.....

.....

WILLIAM NEWTON.

The Speed of Ropes.

Editor American Machinist:

In referring to this subject and the criticism by "M. E." of what I had to say regarding excessive speed, I would like to say that very frequently it does happen that speeds may be such and wheel diameters such that one is compelled to allow ropes to run more quickly than the velocity of maximum efficiency would appear to demand, and I think that to some extent the endeavor to keep down the rope velocities has led to the use of smaller ropes in order that the driven pulleys might be kept small, to suit the speed and reduced size of the driver, and of a diameter so many times that of the ropes. But what I wished more particularly to point out was that there were frequent occasions where ropes could be made to do very excellent work, but where the maximum possible velocity could not be brought anywhere near to even 4,000 feet per minute. High speeds of rope have been so insisted upon that there is a real hesitation to use them where they can only be run at, say, 2,000 feet, even though they are really the best and most suitable means of driving that can be applied in the particular instance.

The engineer who had the work in hand in an instance coming under my notice, knew of plenty of successes at speeds of 5,000 feet, but felt some hesitation for his own place simply because he was absolutely limited by space and pre-existing conditions to a low speed.

Going into the question with him I pointed out that there were no real objections in principle to a lower speed than our standard 5,000 feet; that the work done at 2,500 feet would be considerably above half that done at 5,000 feet; the general friction would be less; the centrifugal stress very much less, accounting for the larger proportion of useful work to be got from the ropes; that, in fact, by reducing the speed from 5,000 to 2,500 feet four ropes would still do the work of three at the higher speed, and, therefore, with his conditions fixed for him by his buildings he need have no hesitation in choosing ropes so long as he used only the same gross tension in them, for they would prove more enduring, and this was rather an important item in the case of machinery which was not wanted to do much idle time, but had been designed perfectly interchangeable with a view to reduce the stoppage for repairs or renewals.

"M. E." is perfectly correct about English practice in rope sizes. My recollection points to 2 inches having been quite a standard size for cotton ropes in the early 80s, but 1¾ inches and 1⅝ inches are much more frequent now.

The advantage of a large rope is, of course, in the smaller breadth of pulley, necessary, which is of value where a heavy wheel is carried by a shaft which must bend more or less—more, if of too big a span, rather than less. To get over this difficulty most engine builders keep the span as small as it can be made by bringing the shaft bearings close to the wheel boss though they are limited in this direction by the necessity of driving the valve gear, and must have a pair of bevel wheels on one side of the boss, at least, unless they are prepared to drive from an outer crank.

I may have laid too much stress upon the loss due to pulling the ropes out of the grooves, and have, perhaps, allowed too little for slack-side tension. My own ready rule for rope-proportioning has been to allow 600 pounds total tension in a 1¾ inch rope, and subtract one tenth for slack-side tension. Even with this my rule only gives 49 I. H. P. for a speed of maximum effect, as against $54\frac{7}{9}$ I. H. P. by a rule much used in Lancashire.

I think that the printers must have made an error in regard to the weight per foot of cotton rope being only 0.3 times its diameter. At this rate a 1¾ inch rope would only weigh about one-half pound. Actually, it weighs a pound by my tables which were given me by a ropemaker who does not overload with lead, but spins a pure rope of American cotton. My table gives as follows:

Diameter of rope.	¾″	⅞″	1″	1⅛″	1¼″	1⅜″
Weight per foot...	.18	.25	.33	.40	.50	.60
Diameter of rope.	1½″	1⅝	1¾	1⅞	2	
Weight per foot.	.72	.81	.98	1.125	1.3	

"M. E.'s" rule is correct for a 1-inch rope, but cannot, of course, be correct for other diameters. Should it not have been $W =$ weight per foot $= 0.3 \times$ diameter^2? This would very closely agree with my tabular numbers. I have also been informed that a 2-inch rope of another maker contains 80,000 threads of No. 32's twist, that is to say, it contains so many threads of a size such that it takes 32 hanks of a single thread to weigh one pound. A hank is 840 yards. Now, 80,000 feet of such yarn weigh almost exactly a pound, for they measure $\frac{80{,}000}{840 \times 3} = 31.75$ hanks, and this leaves 30 per cent. for the twisting of the yarn into strands, and of the strands into rope, which will not be far from practice, and would give the tabular weight 1.3, as above. Cotton ropes do not require much lubrication in the sense that it is required by ropes made of the rough fiber of manila hemp. Merely a slight surface dressing is all that is required. For small ropes so common in spinning machinery, and from ½ inch to ¾ inch diameter, it was our custom to prevent the fluffing of the ropes on the surface by a light application of a mixture of black-lead and molasses (treacle, as the Lancashire people call it), but only enough should be used to lay the fibers, put upon one of the pulleys in a series of light dabs.

For the working strength of a hard or firmly made rope, the rule is very simple, namely, 600 times the weight per foot of genuine rope. It would appear that there are two sorts of cotton rope made, for in Nystrom's pocket-book there is a table of rope particulars, in which the weight per foot is given as only 0.6 that of English cotton ropes. It is clear that these light ropes must be loosely put together to weigh so little. Is it possible that ropes like this have been tried for main driving in America? If so, this may account for the preference given to manila, which is looked upon here as inferior to cotton, and it always occurred to me as strange that manila should be preferred in America, when the standard English rope, evolved from a longer experience, should be of American cotton. There is a rope made of cotton for which great claims are made. It is built up of served strands and these are either very lightly twisted or not twisted at all, the serving being the only consolidating power. They are very light, and part of the weight is, of course, made up of the serving so that they carry a lot of useless loading which must tell at high speeds. It is said that they are durable, but if it were not that all ropes are worked with a high margin of safety, I think they would show signs of want of tensile strength, and it would appear that "M. E." would agree in this.

As this discussion has arisen out of the question of the use of ropes at low speeds, I will endeavor, if it be possible, to secure a record of the proportion of the indicated power which is absorbed by the machinery driven by the ropes, to communicate the results. So far, only an estimate can be made by guessing at the probable power to be conveyed, but if an indication can be taken of the engine when driving the rope section alone, it may be of interest whether successful or unsuccessful to know the effect of slow-speed ropes.

W. H. BOOTH.

Tool-room Suggestions.

Editor American Machinist:

Mr. William H. Steadman in your issue of May 31st wishes to hear from some one who has wrestled with tool-room systems.

In this progressive age when every one is exerting his best efforts to produce the most at the least cost, the tool room, properly equipped and conducted, is an important factor in connection with systematic shop management.

It is true there have been many systems tried that have failed to give perfect satisfaction, but the trouble has been not so much in the system as in the manner of carrying it into effect. Any manufacturing establishment wishing to avail itself of the advantages of a tool room can by a little inquiry of its neighbors adopt a system that will be best suited to its needs.

There are several types of tool rooms to select from. There is the tool room that is used only for the storage of tools when not in use. This is generally in charge of the shop or department foreman, who is responsible for the condition of the tools, and it is his duty to see that they are in proper condition when required for use. This relates to special tools, such as jigs, fixtures, etc., rather than to general tools, and if the nature of the work requires a large number of such tools, the foreman designates some person to look after them, charge them to whoever takes them out, and see that they are in proper condition when returned. In some shops we have visited they have a special place for each jig, fixture, or gauge, whether it weighs a hundred pounds or one-quarter of an ounce, each piece fitted in cupboard or drawers, and both fixture and place where it is kept marked with the name and part of the machine to be operated upon. This is also recorded in a book kept by the man in charge of the tools, which book gives the number or location of the cupboard or drawer where the tool may be found when required. There are different ways of marking tools of this character. Some stamp on the tool the whole story of the machine and operation, which story is sometimes larger than the tool. A simpler way is to number the tool or fixture and let the record book tell the story.

Then there is the tool-room department, suitable for the smaller shops, which may consist of cupboard and convenient drawers to keep drills, reamers, taps and general tools required, as well as files, emery cloth, oil and cotton waste, and such other supplies as may be required. This may be in charge of some person otherwise employed who will give it his attention when required.

If a tool room is of advantage to a large shop, it is certainly so to the one that desires to grow large, and it is much easier to grow up with a good system than to change from a bad one.

But the tool room of most importance is that which is most suitable for the larger manufacturing concerns; on account of the number of men employed and the varied character of the work, requiring a larger range of tools to be kept in constant readiness for use. In this tool-room department it seems best to combine the storage and construction of all general tools, so that they may be kept in proper repair by the man in charge. It would be useless to attempt a plan of such a tool room for the reason that the need varies with the work produced, but a good plan in starting one would be to take about four times the space you think you require, and even then the chances are that inside of ten years you will be cramped for room. A few general suggestions culled from experience may be of value.

Organize the tool room with two separate departments under the charge of a competent man; one department for storage of all general tools as before mentioned, with as many others as the needs of the work require; all to be kept in drawers or on shelves convenient for delivery to the workmen who may be furnished with checks to be left in exchange for the tool taken. This check answers a double purpose. It places a responsibility on the workman to return the tool in good condition when he is through using it, and acts as a record of the tool when out of its place in the tool room. A cupboard for holding files, partitioned to keep the different kinds required separate, so they may be easily found; files to be furnished to workmen only on the order of the foreman in immediate charge of the men, as the tool-room foreman should have nothing to do with the workmen in the shop, except to furnish what is required in the way of tools and supplies.

A suitable place for keeping cotton waste and oil. For the latter, the oil cabinet is very convenient, as it has a double tank—one for lard oil, the other for lubricating oil. Each holds a barrel and is provided with pumps to supply either kind, as required. These cabinets are made in such form as to keep the surroundings clean. This department of the tool room should receive great care in laying out. Have all tools convenient to the person in attendance, so the workman will not be obliged to wait for what he calls for. This waiting to be supplied at the tool room delivery window is one of the drawbacks of the tool-room system; but with a tool room conveniently arranged, the evil is much less than to be obliged to hunt for tools in nooks and corners, or may be in the scrap heap, as is often the case in shops where no tool room exists.

The man in attendance is an important factor in this department of the tool room. He does not need to be a toolmaker, or even a mechanic. A young man competent to learn the names of tools, quick and active, with good memory, are the qualifications required. He should be slow to anger, reserved in manner without being sour. A man of too social a disposition is apt to engage over much in conversation with the workmen in waiting, thus delaying them from their work and lessening his own value to his employer without being conscious of it. In this position the right man in the right place is the only man to have.

The tool-making department of this tool room should be provided with such tools as the nature of the work requires; but a few essentials would be: a first-class engine lathe, universal milling machine, universal grinding machine, cutter and reamer, and drill grinding machines; speed or hand lathe, with the necessary tools that go with such machines, cupboards for holding stock tools, so that the delivery department may be always supplied with sufficient tools to meet all demands. It is much better to have tools in stock waiting to be used than to have workmen waiting for the tools to be made. When we had a tool that was worn out, we used to go to the smith shop and listen to the blacksmith's story while he dressed the tool; now we take it to the tool room and get a duplicate. The tool room is the proper place for standard gauges, and a system of inspection instituted to keep them to standard size, for gauges, like other tools, will wear, and the time to find out that they are not in good condition is before a bad result is obtained. By having all gauges inspected at stated times very small expense is incurred, and all danger is practically avoided. This may apply not only to gauges kept in tool rooms, but to gauges in use in special departments of the works. A record of these should be made, so that they may be looked after.

The tool room is comparatively a modern institution in connection with the workshop. It has come to stay. In viewing it from a distance it may seem an expensive luxury, but whoever heard of its being abolished when once adopted in any workshop?

A WRESTLER.

Not Entirely New.

Editor American Machinist:

It appears that the home-made reflector I described, and which appeared in your issue of May 24th, has been upon the market some time, as Mr. Maule has sent me the inclosed (formerly of Pancoast & Maule) circular which explains itself.

His reflector is, of course, more elaborately made than the one made of tin, and which was entirely the result of a few experiments without knowing that such a device was on the market.

C. A. CALVERT.

The Speed of Ropes.

Editor American Machinist:

In my letter on the above subject which appeared in your issue for May 17th, I note one or two printer's errors, which need correcting.

In the first column, line 7, from bottom, "weight of rope, wheel and axle friction," should read "weight of rope-wheel and axle friction."

Again, in the center of the second column there is printed "the available power transmitting tension must be diminished correspondingly at speeds sufficiently low to enable centrifugal tension to be disregarded; the difference of tensions, etc." This should read "the available power-transmitting tension must be diminished correspondingly. At speeds sufficiently low to enable centrifugal tension to be disregarded, the difference of tensions, etc."

Also, the expression for the weight of ropes, given in column 3, should read "about 0.3 diameter ^{2}," and not 0.3 diameter, simply, as printed.

M. E.

Whitewash for Shops.

J. G. Hoyt, superintendent of the Campbell Press Works, writes us:

"Will you kindly ask your contributors what they know about making whitewash for factory purposes? That is, we would like to know how to make a whitewash that can be put on to the walls and ceiling of the works, that will be durable and not crack and shatter off. We are aware that there are several ways of mixing this up, but there may be some way better than what we now use. If so, we should be pleased to hear from anyone concerning the matter."

A whitewash recommended for outside work is made by slacking half a bushel of lime in a tight vessel large enough to hold about a bushel, pouring boiling water over it until covered. When slacked and stirred, add two pounds of sulphate of zinc dissolved in water, and then add water to make the proper consistency. For inside work add to a pailful of this two quarts of thin size.

We should be glad to hear from our readers who may have had experience in this line. Whitewash is an important matter in machine shops, and there are plenty of shops that would seem to take a new lease of life and be much increased in efficiency by a liberal coat of it.

Tests of Punches.

George S. Allen, in his Case school graduating thesis, gave an account of some experiments with punches. The experiments were made to determine: (1) Which of the various shaped punches now in common use for punching iron and steel did its work with the least maximum pressure, and the relation of unit stress to distortion as the punch passed through the plate; (2) the effect of clearance upon the power required by the punch; and (3) the effect of the form of punch and amount of clearance upon the tensile strength of the punched plate. The results of the tests may be summarized as follows: (1.) A punch, to work easily and not injure the metal, should not be cupped out. (2.) A double punch—that is, one which first punches a small hole and then reams it out by means of a shearing counter punch—leaves the plate stronger, but requires at least twice the power necessary to run a flat punch. (3.) The ordinary flat punch leaves the plate about 90 per cent. as strong as a drilled and reamed plate. (4.) A milled spiral punch is preferable to one which has the spiral cut in a lathe. (5.) A single spiral requires less pressure than a double one, and leaves the metal about as strong. (6.) A single sloping or whistle-shaped punch does its work with the least consumption of energy. (7.) Between the limits of 0.01 inch and 0.05 inch clearance has no effect on the power consumed by a punch or upon the strength of the punched plate.

A Chinese engineer, educated in New Haven, Conn., is about completing a telegraph line, 3,000 miles long, across the Gobi desert, from Pekin to Kashgar, Chinese Turkestan. It has been three years under construction, and poles in places were hauled 600 miles. Branch lines connect it with the Russian system.—*Electrical Review.*

Mr. E. Payson Trumbull, formerly with the Deane Steam Pump Co., of Holyoke, has accepted a position as representative of Henry R. Worthington, 86 Liberty street, New York.

AMERICAN MACHINIST

Communications relating to the reading columns should be addressed to the Editor. All other communications should be addressed:

AMERICAN MACHINIST,
203 BROADWAY, NEW YORK.

PUBLISHED WEEKLY AT
203 Broadway, New York.

HORACE B. MILLER, Pres't and Bus. Manager.
LYCURGUS B. MOORE, Treas. and Sec'y.

F. F. HEMENWAY, Editor and Mech. Engineer.
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$4.00 a year to Other Countries, postage prepaid

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Transient, 35c. per line, each insertion.
"Business Specials," 50c. a line.
No Commission allowed to Advertising Agents.

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Publishers' Agents, New York.
DEALERS SUPPLIED BY
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Subscriptions received in Paris, France, by E. TERQUEM, 31 Boulevard Hausmann, at 21 francs per annum, postpaid.

Subscriptions received in Australia by W. WILLIAMS, 17 and 21 Fink's Buildings, Melbourne.

NEW YORK, JUNE 28, 1894.

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Some Causes of Unrest.

No thoughtful citizen can, in view of recent events in the coal producing districts of this country, dismiss from his mind some feeling of apprehension. There has been much lawlessness and, in some places, a nearer approach to absolute anarchy, perhaps, than has ever before been witnessed on American soil. Not all the acts of violence seem to have been committed by the striking coal miners; the "deputies" have done their share of these, but for the wrecking of railroad bridges and trains, and for the destruction of mining property the striking miners are, of course, immediately responsible, though no one is wise enough to say just what proportion of the blame should be placed upon others.

All, except anarchists, or the more euphemistically termed individualists, will agree that a civilized people must maintain some form of government, and that behind this government there must be a potential force, a force capable of compelling obedience to laws and respect for the rights of others when necessary. It is probable that there are—and perhaps always will be—those who must feel this force occasionally, but when it becomes necessary to employ it too often or too much, or to great numbers of people, then it is time to do some thinking, whatever of fighting it may also be necessary to do.

It is easy for those of us who can at present manage to keep ourselves comfortably fed, clothed and housed, to simply demand the prompt imprisonment, shooting or hanging of law breakers, and when that is done imagine the whole difficulty settled. But blood poisoning cannot be cured by surgery alone; there must be treatment to cure the blood poisoning else there will be only a succession of surgical operations and final dissolution. It is our firm belief that ours is the best form of government yet devised by man, but no sane man can think it is perfect or that by it the nearest possible approach to justice, and the greatest good of the greatest number are always secured.

It is an indisputable fact that the security of government such as ours, and the prosperity of the people as a whole rests, and must continue to rest finally upon what we are accustomed to regard as the lower stratum—the common laborer, and it can scarcely be denied that in legislation and in the courts this class and others similar, have been neglected; that money, especially when massed together, has wielded too great an influence; that there has been too much "representing millions of dollars," and too little representing millions of men with an inalienable right to life and the pursuit of happiness.

Ours is not a journal of economics and we do not propose to enter that field, but since it is charged by many that the increasing use of machinery and the large amount of capital invested in such machinery is the prime cause of social disturbances, builders and users of machinery are perhaps especially interested in the problem. For our part, it seems unreasonable that a machine, which is simply a means of increasing a man's power to produce desirable things, can become a means of oppression under otherwise just conditions; but that there is some social force which is working in the direction of oppression is being taught in many journals read by workingmen, and this teaching is having its influence, whether right or wrong, and the time has come when every citizen should pay some attention to such matters.

It is desirable, it seems to us, that, a sharp line of demarkation should be drawn between the capitalist or the manufacturer on the one side, and the monopolist or manipulator on the other. Sometimes the same man may assume all these characters, but it is our belief that the manufacturer, pure and simple, is in these days, being charged with oppression, extortion and other sins, of which he is in no wise guilty, simply because the distinction is not made between manufacturing operations, pure and simple, and the operations of monopolies, trusts, etc.

False Reports.

President Williams, of the Chemical National Bank, yesterday said that in the published reports of his conversation with the Clearing House Committee men on Tuesday, statements had been attributed to him which he had not made. He had not said that "75 per cent. of the manufacturing and commercial business of the country was in the balance between solvency and insolvency," or made other statements of like tenor. He had no thought to that effect.

The above extract from a daily paper illustrates the necessity for making a very large discount on any report of a commercially calamitous nature.

It ought to be well understood that there are very many men who, to advance the stock gambling or the supposed political interests of themselves or their employers, do not hesitate to spread false alarms, and make things appear much worse than they actually are; and when they can put their lying reports of actual or impending disaster into the mouth of the president of such a prominent and well-known a bank as the one mentioned, they are so much the better pleased. Penitentiaries ought to yawn for such fellows, but, as they do not, the next best thing is for sensible people to pay no attention to such reports unless they are definitely authenticated.

One of the most amusing characteristics of certain of our English cousins who are continually harping upon Americans' "brag" and "bounce," is shown in the fact that, usually in the very act of scolding us for bragging, they surpass us in "brag" and "bounce." *The Steamship*, for instance, says of Charles H. Cramp's letter asking to be allowed to make tenders on war vessels for England, that it shows "downright cheek," and after reproducing it, says:

It is scarcely necessary to treat such a letter seriously, there are so many objections to the proposal. It is most probable that it was intended as a piece of bounce, pure and simple, and never expected to be acted upon. The British Admiralty never could or would entertain such a proposal, and the only effect of sending schemes or plans would be to have them immediately copied. We have all along been too confiding in showing our plans to other nations, and there can be no doubt that all the recent efforts of shipbuilding in the United States have been direct copies of what has already been done in this country.

We will admit that there has been a good deal of bragging done in this country first and last, but we do not recall any more aggravated case than is shown in the last sentence of the above quotation, in view of all the circumstances.

We are sometimes led to think that a seafaring life, or, pursuits connected with shipbuilding, such, for instance, as editing marine journals, have a decided tendency to develop the habit of bragging, on either side of the water. We have some notable examples of this here, and there are just as notable ones in England, only an American usually knows when he is bragging, while an Englishman does it in an unconscious way that is highly diverting.

Hiram Maxim seems to have made the mistake of supposing that he could perpetrate an innocent joke in England in the same way he might if at home, and have it understood in the same way.

The inventors of a bullet proof cuirass were claiming great things for their invention, and offering to sell it for a large amount. Maxim bethought him that tempered nickel-steel would do more than claimed for this new cuirass, and so stated that he could make a superior cuirass, and would sell the secret for $2.

Vast crowds of people came to see his test, and though he did all he promised, the simple means taken to do it provoked the vast concourse of Englishmen who visited his place, and considering themselves imposed upon, they nearly mobbed him, and the more he tried to explain the darker things look for him. *The Engineer* now reads him a severe lecture, and says he "conveyed the general impression that he was an unblushing exhibitor of American bunkum." As a matter of fact, Mr. Maxim's letter was only his satirical way of calling attention to the fact that the alleged bullet-proof cloth was not wonderful nor worth the amount asked for it. It would have been so understood here as a matter of course. That is because we can tell when a man is showing himself to be an "unblushing exhibitor," etc.

Another notable triumph of the principle of arbitration in wage or labor disputes is that of the Mobile & Ohio decision. The officers of the road thought there should be a reduction of 8 per cent. in wages. The men thought differently, and, instead of fighting upon the issue, both sides agreed to continue the operation of the road as usual, pending the decision of a committee of arbitration. The committee, consisting of G. W. Boyd, president of the Merchants' Exchange, of St. Louis, Lieut.-Gov. J. M. Gill, of Illinois, and F. M. Alexander, a clergyman living on the line of the road, agreed that there should be a reduction of 4 per cent. for a period of four months from June 1, after which wages are to be restored and continued indefinitely, sixty days' notice being required of either party desiring or proposing a change.

The decision was promptly and heartily ratified by both sides.

Death of Samuel W. Porter.

The Master Armorer of the U. S. Armory at Springfield, Samuel W. Porter, died the 19th inst., of diphtheria, following an attack of tonsilitis.

Mr. Porter was born in Ware, Mass., in 1834, and in 1856 entered the service of the government as a tool maker. In 1866 he was appointed master machinist, and in 1879 master armorer. Mr. Porter was a skillful mechanic, was generally well-liked by his associates, and was universally respected in the community in which he lived.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(304) E. L., Lockport, Ill., writes: I would like to have some information in regard to a friction pulley. We have one here on a hoisting machine; it has a face 7½ inches wide, but it will not do the work. The question arises, will the friction be increased by increasing the width of face without making a change in the levers, etc., so that the pressure will be the same as before? I think it will, but others say it will not. *A.*—The friction can not be increased without increasing the pressure. Increasing simply the width of face will not improve matters. Increasing the diameter of the pulley will cause the friction to act with a greater leverage and be more effective.

(305) A S., City of Mexico, writes: In the AMERICAN MACHINIST, of November 23d, last, mention was made of an "extractible tube" boiler made by R. Wolf, of Magdeburg, Buckaw. Kindly inform me if there is any agency for these boilers in the States? Have they been adopted anywhere, and if so what satisfaction are they giving? I should like to have your own opinion about these, their durability, steaming capacities and price? *A.*—The only advantage claimed for these boilers is that the tubes can be removed in a body for cleaning purposes. Otherwise there is no difference between these boilers and the ordinary tubular cylindrical boilers. There should be no difference in the steaming capacity of these boilers and others of the same type, having the same heating surface, and the same may be said of durability. We have not seen any of these boilers in use, and we are inclined to believe that there is no agency for these boilers in the United States. We can give you no information in regard to price, as we are not in the business of selling machinery.

(306) L. T. R., Havana, Cuba, writes:

We have a 4x4 inch engine, made on the same principle as the Shipman oil engine. The engine has two cylinders, single-acting; we are going to place it in a 20 foot boat, and want to use a condenser for the exhaust steam, and wish you to give us the amount of cooling surface the condenser should have. We shall carry a steam pressure of 100 pounds; the engine is to run at 475 to 500 revolutions per minute, temperature of injection water about 70 to 75 degrees Fahr. The boat is to run in the bay, hence salt water will be injected into the condenser. We do not care to have any good vacuum, and we shall not use an air pump; we shall use a circulating pump and want to condense only the exhaust steam so as to feed it into the boiler. The enclosed sketch shows the design of condenser we propose to adopt. It consists of two horizontal pipes connected at one end, each pipe contains a set of tubes; the injection water enters into the lower pipe and passes through the tubes, then passes through the tubes in the upper pipe and overboard. The exhaust steam enters the upper pipe circulates around the tubes, and the water due to condensation flows out through a nozzle at the bottom of the lower pipe. Please give the amount of cooling surface, diameter of upper and lower pipes, and diameter and length of tubes. *A*.—We should use a cooling surface of 21 square feet, which will require 32 seamless drawn brass tubes, (16 inches each set), $\frac{5}{8}$ inch outside diameter, No. 20 Birmingham wire gauge in thickness, placed about 1 inch from center to center, length of tubes 4 feet; diameter of pipes, 8 inches.

(307) G. C., Belleville, N. J., writes: I have a pressure blower which I wish to use for carrying steam from a building in the same way as smoke is carried from a forge shop. The blower has four blades, 23 inches diameter. Now, I propose to close one of its sides (the side next to the pulley, and run a pipe from the other opening about 9 inches diameter), which will be the main pipe, and take branch pipes from that to the places where required. This is in a laundry in which there are four wash cylinders, and one large old fashioned dash wheel. In the process of washing live steam is turned into this wheel, and the result is that the room is clouded for a period of 20 minutes to half an hour, to the detriment of the machinery. I propose to put a hood over this wheel, and lead a pipe from it to the main pipe, and run the blower at 1,000 to 1,500 revolutions per minute, and discharge out of doors. About 20 feet of pipe will be needed altogether. Now, will this blower do the work? *A*.—Your data does not give the amount of work the blower has to do, but from the general description of the laundry, we should say the blower is large enough. We do not see any necessity of closing one side of the blower and attaching a pipe to the other side. Run a pipe from the discharge opening of the blower to the bottom of the hood over the wheel, so as to give the escaping steam the proper direction of flow, causing it to pass out into the atmosphere by means of a pipe attached to the top of the hood. A mechanical engineer may be able to arrange the ventilation of the room in such a manner as to avoid the use of a blower, and put you to less expense than will be incurred without his advice.

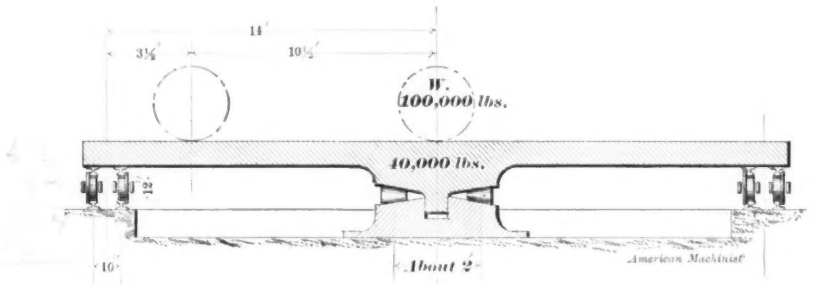
(308) J. J., ——, O., writes: Kindly give me data and formula to solve the following problems: The accompanying sketch is of a circular turn-table, its support being at the center on the conical rolls; the outer diameter is merely steadied or held up by two separate trains of idler wheels, the wheels being pitched about 18 to 20 inches apart around the total circumference of each respective circle. I would like to know what force will be required to revolve the turn-table when the center of gravity of the load on table is located 10½ feet out instead of over the center of the conical rolls; the applied force is to act at the 14 feet radius. What force in pounds acting at the 14 feet radius will be required to bring the table from a state of rest to a revolving speed of 88 feet per minute in a space of 11 feet, or $\frac{1}{8}$ of a revolution? The center of gravity of the load being at 10½ feet from the center of the table. *A*.—In the first place, let us find the time it will take to obtain a linear velocity of 88 feet per minute in traveling through a space of 11 feet. A velocity of 88 feet per minute is equal to a velocity of $\frac{88}{60} = 1.466$ feet per second. Now, the time required to obtain this velocity is found by the following formula:

$$\frac{2 \times s}{v} = t,$$

in which s = distance in feet traveled, 11 feet in this case, v = velocity in feet per second, and t = time in seconds. Substituting the known values for the symbols in the formula, we have

$$\frac{2 \times 11}{1.466} = t = 15 \text{ seconds.}$$

In finding the force required to rotate the turn-table we must reduce the given linear velocities to angular velocities. This is accomplished by multiplying the number of revolutions by 6.2832, because there are 6.2832 radii in the circumference of a circle. The velocity is given at 88 feet, which is practically equal to a circumference of a circle whose radius is 14 feet, hence the angular velocity, after the table has traveled through $\frac{1}{8}$ of a revolution, will be 6.2832 angular units per minute, or $\frac{6.2832}{60} =$



.1047 angular units per second. Our next step will be to compute the force required to give this velocity to the table only. For this we employ the following formula:

$$f = \frac{v_1 \times I}{r \times t}, \qquad (1)$$

in which v_1 = angular velocity per second, r = radius in feet at which the force is applied, t = time in seconds in which the given velocity must be attained, and I the moment of inertia of the table. We shall here assume that the table is circular in form, and its weight equally distributed throughout, and neglect the projecting bearing at the bottom of the table. Under these conditions we have simply to deal with a plain disk. The moment of inertia of a plain disk revolving about its center is found by multiplying the mass by the square of the radius of the periphery and dividing the product by 2. The mass is found by dividing the weight of the table by 32 2; hence the mass will be equal to $\frac{40,000}{32.2} = 1,242$; now assuming that the radius of the outer circumference of the table is 16 feet, we have for the moment of inertia of the table

$$\frac{1,242 \times 16^2}{2} = 158,976.$$

Substituting the known values for the symbols in formula (1), we have

$$f = \frac{.1047 \times 158,976}{14 \times 15} = 79.2 \text{ pounds.}$$

which is the force required to give the table (without the load) an angular velocity of .1047 angular units, friction not considered. For friction we may adopt a coefficient of .005, this will give us a resistance due to friction of $40,000 \times .005 = 200$ pounds; but the force to overcome this resistance acts with a leverage of 14 feet; hence the force required to overcome the resistance of friction will be $\frac{200}{14} = 14$ pounds, fraction neglected. The total force to give the table the required velocity will be 79 2 + 14 = 93.2 pounds. In order to compute the force required for giving the load the given velocity, we again use formula (1). To find the moment of inertia I in this case we should know the form of the load, we may, however, neglect this without falling into a very serious error, and assume that moment of inertia is equal to the mass multiplied by the square of the radius to its center of gravity (10½ feet). Hence

$$I = \frac{100,000}{32.2} \times 10.5^2 = 342,391.$$

Substituting the known values for the symbols in formula (1) we have

$$f = \frac{.1047 \times 342.391}{14 \times 15} = 170.7 \text{ pounds.}$$

We may assume that the outer rollers take $\frac{100,000 \times 10\ 5}{14} = 75,000$ pounds of the load, and taking the same coefficient of friction as before, we have a resistance due to friction $75,000 \times .005 = 375$ pounds. For the friction of the other 25,000 pounds which rest on the conical rolls, we have:

$$\frac{25,000 \times .005}{14} = 9 \text{ pounds.}$$

Now, the total force to give the required velocity to the table and load will be:

$$93\ 2 + 170.7 + 375 + 9 = 647.9$$

pounds. 2. By what formula would you compute the diameter, length and angle of the conical rolls for a pitch diameter of about 2 feet, as shown, supporting a load of 140,000 pounds? What would be the horizontal pressure on each roll tending to thrust it outward? *A*.—We should not allow the pressure on each roll to exceed 10,000 pounds; under these conditions, we will need $\frac{140,000}{10,000} = 14$ rolls; in a pitch circle of 24 inches, the mean diameter of each roll will be about 5 inches; the length we should also make 5 inches. To determine the angle, let Y' Y, Fig. 2, represent the center line of the turn-table; draw X' X perpendicular to Y' Y, cutting the latter in the point X. Let d' d be the mean diameter of the roll at 12 inches from Y' Y; through the d' and d draw lines to X, as shown; these lines will give the taper of the roll. To find the horizontal pressure tending to force the rolls outwards, draw a line a b perpendicular to X' X, and lay off to any scale on this line the downward pressure on

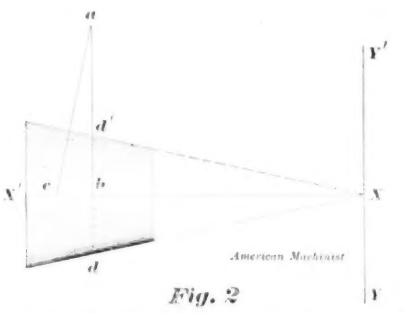


Fig. 2

one roll; if, for instance, the downward pressure on each roll is 10,000 pounds, and we decide to use a scale of 1,000 pounds to the inch, then a b will be 10 inches long; through a draw a line a c perpendicular to X d', cutting X' X in the point c. Now, c b will represent the horizontal pressure tending to push the roll outward. If c b is one-tenth the length of a b, then c b will represent $\frac{1}{10}$ of the vertical pressure. Or, in any case:

$$\frac{c\ b \times \text{vertical pressure}}{a\ b} = \text{horizontal pressure.}$$

Here friction has been neglected; if this is taken into account the horizontal pressure will be somewhat reduced. 3. What would you believe to be the best manner of keeping the rolls in place? *A*.—We should use collars for this purpose.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Grant's Gears, Lex'n, Mass., & Phila, Pa. See p. 12

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Turret Drills, 6 spindles. A. D. Quint, Hartford, Ct.

"National" Lathe Chucks. Best made, page 15.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 157 William St., N. Y.

Davis Key Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty St. N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Cheap 2d h'nd lathes, planers shapers, drill presses punch presses, etc. Am. Tool Works. Clev'd, O.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

"Pumping Machinery." New book, 450 pp. 8vo, 270 Eng. Prospectus free. W. M. Barr, 3223 Powelton avenue, Philadelphia, Pa.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

Grinders' Supplies—
Emery, emery wheels, grinding machines, knife powders and sharpeners, paste and liquid polish, whetstones, etc., etc.; quick process and large stock. Customers annoyed by the delays due to long processes and small stock can get goods in a hurry by buying of the
Tanite Co., New York City, Cincinnati, Ohio, and Stroudsburg, Pa.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

Twenty-seventh Annual Convention of the American Master Mechanics' Association.

Two years ago this association met at Saratoga, and the general expression of the members was that it was an excellent place for the purpose. Saratoga is not, in any sense, a railroad center; there is nothing there that would naturally take railroad mechanical men away from the purposes of meeting to discuss mechanical matters. More railroad mechanical men assembled at Saratoga this year than ever met together before in the history of the association.

While there were no startling questions brought forward for discussion such questions as did come before the association received more than usual attention. Beginning Monday, June 18th, the sessions continued for three days, and were well attended throughout.

It had been announced that Chauncey Depew would make the opening address Monday morning, but he was prevented by sickness, and the breach was filled by Judge Lester, of Saratoga. What Mr. Depew would have said is problematical, but Judge Lester acquitted himself with a good deal of credit, and welcomed the master mechanics to Saratoga very nicely, indeed. Amongst other remarks that showed a comprehension of the subject about which he was talking, the following is pertinent:

We appreciate, gentlemen, the importance of your association. We know how much the people of these United States, as well as the whole world, owe to the inventive genius, the patient labor, the skill, and, above all, the honest and conscientious efforts of the master mechanic. We know how much he has done toward increasing the conveniences and comforts of travel; how much he has added to the speed and safety of those who use railroads as a means of intercommunication, and we have no doubt that your meeting to day and this week will result in an interchange of views, in presenting new improvements, new devices, new inventions which will add to the comfort and happiness of the people of this land.

It seems to me that the railway system is one of the great factors in the advancement of civilization. It brings together different and distant States. It binds together in a common fellowship. It makes it possible that a single government can extend its fostering care over its States and territories, as though they were, as in ancient times, a small and consolidated nation. Not only that, the means of communication between distinct and different nations is such that it brings them into acquaintance, it brings them into respect, it brings them into regard for each other. It puts off the possibility of war, and these iron bands that span continents are bands of fellowship that bind nations together in a common brotherhood. And if the time should come when war shall be no more, when peace shall spread its final triumph over the land and over the world, railways will have had no small influence in bringing about that desired result.

Now, gentlemen, I can only say, on behalf of the people in whose midst you have assembled here to day, that we again tender you our good wishes, in the hope that your deliberations may be satisfactory and profitable; in the hope that you and the world with you, may benefit from it; because, gentlemen, we look upon you as occupying a commanding position in the world. In these days of unrest and unquiet you stand upon a neutral ground, between labor and capital. You are the right hand of capital, are the directors of labor, you have the confidence of both. In times when friction arises between capital and labor, when it is, as it has been during the last few months, fanned into flames of violence, bloodshed and unnecessary destruction of property, you can do much toward allaying this destruction, as you have the confidence of both sides, and restore the good will that should always exist between capital and labor, and I have no doubt that this matter

will be considered by you, and you will do all that is possible for the purpose of perfecting such a result. Again, gentlemen, wishing you success and profit in your convention, we hope when you leave Saratoga and go back to your distant homes, you will carry nothing away from here but pleasant recollections of your meeting in Saratoga.

At the conclusion of Judge Lester's address, President Hickey spoke as follows:

PRESIDENT HICKEY'S ADDRESS.

Gentlemen of the American Railway Master Mechanics' Association:

In the progress of time, and in compliance with the constitution and laws of our association we again assemble in annual convention, possessing, I feel, a unanimous desire of advancing knowledge relating to the principles, the construction, the maintenance and the economical use of railway rolling stock and relative machinery.

In the history of railway service, there have never existed requirements so pressing, nor requiring the exercise of efforts more heroic, aiming at a reduction in cost of operating expenses, than are necessary at the present time. Responsibilities of greater weight and duties of more severe importance never rested on those who are charged with the construction, the care, the maintenance, and the application to service of railway rolling stock than in the period through which we are passing. The industries of the nation are suffering from a commercial and financial depression to a more aggravated degree than has heretofore occurred in its history. It will be admitted that the railways of the country are its chief arteries through which necessarily flow its life giving properties, its progress, its prosperity. They are the common carriers of the people, the existing necessities of the people, and, as a single industry, the greatest employer of the people, and I may add that they promote to a greater extent than any other element the convenience, the comfort and the knowledge of the people.

Bearing these facts in mind, it will require no extra effort of thought to arrive at the conclusion that the railway systems of the country, the most potent factors in every development, with interests so vast, so important, must be affected by the commercial revulsion of the country to an extent more serious than other interests. The interests of the railways, the State and the nation, are so blended in industrial pursuits that increasing prosperity of the one means enhanced values of the others, and in the nature of this relation, must rise and fall together. The interests of our railroads, therefore, are of national importance, and any aid that the members of this association may render in the premises, either individually or collectively, is not merely of local importance, but is a valued step toward restoring national confidence and prosperity.

What has brought about the present deplorable condition of business and the extreme depression in all branches of trade, so far as railway interests are concerned, I will not attempt to discuss.

Whether the extra affliction of railways (which certainly exists) has been caused by overproduction of transportation facilities, untempered legislation, or the incomprehensible policy of rate-cutting, for our present purpose, matters but little. The condition exists, and we, representing an important department of transportation, are in duty impelled to apply remedies of recovery so far as we are empowered, and it is possible for us to do.

For me to outline a plan or formulate a policy of economy that could be followed by the members of this association, would be highly presumptuous. I desire only to impress on you (if further impression were necessary), that the highest duties of the members of this association in convention assembled, are to reason together on the facts here presented, to exchange information on essential matters of official duties, and to give results of experience on practical questions. To discuss subjects with a view to obtaining such practical information from the reports of our committees of research, as will enable us to reach such united action as may render the highest efficiency of service through channels of the greatest economy. While all may agree that the strictest economy in the performance of our duties is necessary, it is but reasonable to admit that there is considerable difference of opinion as to what constitutes prudent action in order to bring about the most profitable results. The surest manner of arriving at this point is by a fair, free and thoughtful discussion of subjects presented, and by members imparting to the convention all information they may possess on the subjects under discussion.

Let me again claim your indulgence in considering the cost of operating our locomotives. This expense in the operating department is made up chiefly from the value of the fuel used, the wages paid enginemen and the cost of repairs in maintenance, and are of relative importance in the order named. Assuming that the total cost of operating locomotives is twenty-five cents per mile, which for many of the largest roads is rather below than above the average, in making 1,000,000 locomotive miles, we have an expenditure of one quarter of a million dollars, and this proportion, approximately, is 30 per cent. of the total operating expense of a large railroad. The fuel used being the largest item of locomotive expense, to devising means looking to its reduction per ton hauled, the members of this association have applied themselves for years. Improved features in boiler construction, size, length and relative situation of tubes, relative proportions of fire box and tube-heating service, the introduction of brick arch, extension fronts, straight stacks, all have had due share of attention, yet figures of locomotive performance remain, and monument like, remind us that we must seek channels of greater efficiency than any yet reached, towards a reduction in the expense of generating locomotive power and energy.

Doubtless the most important move yet taken toward economy in the use of fuel has been in the introduction of the compound engine. In the opening address to this association one year ago, the following passage may be remembered:

"Highly drawn service tests between simple and compound locomotives are not always commendable because the usual conditions under which the tests are conducted are so widely different from those obtained in ordinary service that results thus procured should hardly be regarded as conclusive. Comparative tests can be obtained with a much greater degree of profit by placing the engines in regular and parallel service, extending over a period of several months or years, basing their performance on the tonnage hauled. This demonstrates not alone their fuel saving properties, but establishes to a certainty their relative costs of maintenance.

The sentiment expressed here has given rise to more extended tests in this particular way, and I am reliably informed that results thus obtained give undisputed assurance that the compound locomotive contains practical principles of economy, to a greater extent than any other known method of locomotive construction. Speaking from personal experience with a compound extending over a period of more than three years, I am convinced that with improved construction of the compound principle, it possesses superior qualities of motive power, as well as economical features in the use of them. During this period the compound engine I refer to was engaged in ordinary freight service, her trips being blended with a number of simple engines of equal weight and capacity, and hauling equal tonnage per trip, and her record shows a net gain in fuel, over the average of a number of simple engines of not less than 18 per cent., and it may be well to remember that this record has been obtained in the face of the fact, that enginemen, as a rule, do not possess the friendliest feelings towards engines of this type, necessarily leading to carelessness in economy of performance. During the time a close record was kept of the cost of repairs, and while it was a fraction greater than the average of the simple engines, it was a matter of insignificance as compared with her saving in fuel.

Members of this association are often requested to render an opinion as to the wisdom of railway companies procuring the compound type of locomotive for general service. To those who are still in doubt, it may be proper to say, that this question is one dependent largely on local conditions and character of service. The weight of experience is certainly favorable to the introduction of the compound for all ordinary work, provided the engine is in size and capacity, suitable to the service required. Carefulness, however, is necessary in the selection of the best type and the adoption of the most improved construction of the vital parts.

Keeping the foregoing in mind, there will be no risk in purchasing a few compounds, and the experience of others would indicate the move to be a wise one, as there are many reasons to think it would be the means of considerable gain.

As stated, a larger part of the work of our committees in the past has been directed to improving the design and increasing the efficiency of locomotives. While this is one of the principal aims of the association, it is of no greater importance than the necessity of obtaining increased facilities and conveniences for rapidly meeting necessary repairs to motive power. With improved shop tools and the introduction of best known facilities for handling locomotive work, the shopping period is lessened, thus permitting a higher mileage per engine, and not alone lessening the cost per mile for repairs brought about by improved facilities, but enabling us to perform a given amount of business with a less number of locomotives. This is a step in the direction of economy that the members of the convention cannot afford to pass lightly, and I earnestly request your closest attention to the matter.

Having dealt with the proposition of obtaining from our locomotives work of the highest efficiency with the minimum expenditure, together with the necessity of methods tending to rapidity of repairs, lessening them by the shopping period, this condition can only reach the full measure of success by the introduction and use of material possessing the qualities of necessary strength and recognized endurance. When it becomes necessary to spend a certain amount of money on a locomotive for the purpose of placing her in good condition for service, except in case of accidents, it is but proper and reasonable to expect and demand service proportionately equivalent to the amount expended. This result never can be attained if the material used does not possess qualities suitable to the conditions. The character of the workmanship is of high importance, but it is a secondary element to the grade of material entering into any part of the rolling stock. In our zeal towards carrying out the policy of economy we may be led to press too heavily on the established price of material, and while efforts in this direction may be entirely proper, they should never go so far as to cause a reduction in the grade or quality of the articles, or the material in question. When the quality of enduring features of an article is in any way reduced to meet the apparent necessities of reduced price, then economy ceases and the opposite promptly takes place. There is not a point connected with our official duties more worthy of continued remembrance, than the dual facts, that the highest standard of quality in material entering construction or repairs of rolling stock, should be maintained, and that the first cost is insignificant, when compared with the cost of maintenance and replacements.

I would scarcely be doing justice to the subject with which I am dealing, did I not call attention to the good work of the various railway clubs throughout the country in their monthly meetings. Their work is commendable to the highest degree, and the combined fruits of their labor convey a spirit of progress, that must brighten the pages bearing the proceedings of American railway progress. It seems unnecessary to say that the members composing the local clubs represent all classes of rolling stock. In harmony with the views of the members, the club work is extended to cover the design, construction and maintenance of all manner of rolling equipment, the great variety and contrast of subjects being largely the cause of the deep interest taken in the work, and is an essential factor in promoting the value of the proceedings.

It is especially noticeable in club work that men who have in the distant past confined themselves largely to locomotive construction and maintenance, have within the last few years extended their thoughts and efforts to car construction. On the other hand, many of those who have confined their ideas exclusively to cars, are now earnestly extending their efforts to locomotive practice and principles of construction. There seems to be no good reason why this condition of things should not broaden and grow, and there are several excellent reasons for believing that the practice is to be highly commended. With the examples just noted before us, together with the growing tendency of combining efforts to get far-reaching results, and the fact that many of the members of both associations are directly interested in the work of each, would it not be reasonable to assume that an amalgamation of both Master Car Builders' and Master Mechanics' associations, and a blending of proceedings would be productive of results more profitable than can occur in the separate manner in which they are at present working? It seems exceedingly clear that with a consolidation of the associations much routine work and preliminary details can be dispensed with, and by other means, also, lessen the period of performing the work of both. With united proceedings five consecutive days should be ample time to accomplish the necessary substantial work, and this would place the period of holding the conventions on a basis where all who are interested could avail themselves of the opportunity of attending, which under present conditions, and because of limited time, is not within reach of a large number of members who are as deeply interested as those who attend. It is also evident that a union practically means increased membership of both associations, and under the conditions, could hardly fail to enhance the influence, and add to the interest and efficiency of their work. In dwelling on this question, I am inspired only by motives of improving the relative working condition of both associations, of increasing their strength and influence, and of crowning their labors with a higher order of success, and which I feel, if left unsaid, would be untrue to sentiments I have long entertained.

This association has reached a period in mechanical inquiry where its committees of investigation have quite often to deal with subjects requiring deeper scrutiny than facilities for the same can easily be provided for at ordinary railway shops. Testing conveniences necessary to the true solution of many subjects are not always available for committee work, without the necessity of involving local expense, and quite often there are practical difficulties in the way of this. In the absence of suitable testing apparatus to aid committee work, many reports are necessarily based on the uncertainty of ocular proof. In view of these facts, together with the prevailing desire of reaching a true solution of many mechanical points now held in doubt because lacking necessary testing facilities, it seems proper to suggest that the time has arrived when this association should consider the policy of making arrangements with some established institution of learning, whose chief aim would be the promotion of science and the mechanic arts, and which was already supplied, or with the support of this association could be supplied, with the necessary testing conveniences to meet our wants. Could this association secure relations with

such an institution as to enable committees having in hand subjects requiring deep investigation to submit them to the institution, it would be a move of great value, in that it would add weight and confidence to the reports. Reports of committees would then largely partake of a combination of science and practice, admittedly a desirable mixture. This action, of course, would involve the association in considerable extra expense, but the increased value of the reports would much more than offset any extra expenditures involved, and if it could be shown (which it certainly could), that it would be of great value to railway interests, the association could, without doubt, in an official way, get the railroad companies to bear the expense incurred.

I feel a special pride in imparting to you the information that this association is in an excellent condition of prosperity and growth, and that the executive and detail work of the organization has been thoroughly cared for by the unsparing efforts of your worthy secretary.

It is also gratifying to note that your committee of research have pursued their subjects during the past year with unusual vigor and depth of thought. The reports are full of good ideas and interesting suggestions, and I commend them to the careful consideration of the association.

And, now, gentlemen, as we are about to turn over a blank page on which to record the proceedings of this, our twenty-seventh annual convention, may we cling to the hope that our convention labors will be marked with a spirit of progress and advancement that on returning to our homes, we can look back to our efforts here with feelings of duty well performed, and rightly lay claim to the possession of such noble sentiments as were felt by a conscientious and patriotic governor of a Western State, who, on being complimented on his devotion to public duty, replied in terms which, though not grammatical, were exalted and sincere: "I saw my duty and I *done* it."

Up to this time the convention had been held in the village hall—Convention Hall, or something of the sort, it was called. But it was soon developed that no one could hear anything that was said there, and an adjournment was made to the hotel hall—Congress Hall. From that on came the wrestling with the problems that come up in railroad mechanical work.

These problems never get settled, for year by year they come up in an always varying form, and, so it would seem, they will always come to the front. This, however, only seems, for year after year the master mechanics add something to the sum total of actual knowledge; altogether this adding something is a slow process. Every one who gives attention to steam engineering knows how hard it is to establish a fact. There is a certain amount of superstition connected with steam engineering, and this superstition gets hold of railroad men just as it gets hold of other men. But railroad men have this advantage, with them it is mainly a question of getting trains over the road. With mechanical men, in stationary engine practice, the question of coal burned comes always to the front.

CRACKING OF TUBE SHEETS.

was the first question considered. Whether a man has had experience in railroad work, or whether his work has been in stationary or main direction, the cracking of tube sheets, very likely, has bothered him. Sometimes he has put in too many tubes and bad water has worked its result.

That seemed to be the trouble, as shown by the discussion of this question by the master mechanics. Too many tubes and small space between them is a source of trouble in locomotive practice just as it is in stationary or marine practice.

RADIAL STAYS.

Anyone who will give a moment's thought to the subject will be able, in his own mind, to form an opinion as to advisability of supporting the crown sheet of a locomotive boiler by radial stays—that is by stay bolts from the shell proper.

The original method of holding the upper surface of the fire-box of a locomotive boiler was by cross bars. These simply stiffened the surface, preventing its giving any from the pressure to which it was subjected. This pressure was formerly about 125 pounds, but more recently this has been increased to more nearly 200 pounds. At first thought it would seem that stays to the circular part of the boiler—the shell—would be the best means of holding the crown sheet. But there was difference of opinion expressed in regard to this. If the carrying of the water in a locomotive boiler was something fixed by law—or regulation of some infallible sort—then the proper means of staying might be figured as easy as need be. But it came out in the discussion that the water level varied so much as to cause serious trouble. In the discussion that followed this question, John A. Hill said that the conformation of the crown sheet was ordinarily such that low water affected a line of stays simultaneously, so to speak, and when they let go from excessive heat, the crown sheet dropped, as a matter of course.

OILING DEVICES FOR LONG RUNS.

This subject called out considerable discussion.

M. C. Hammett, of Troy, N. Y., had on exhibition his device for the purpose of distributing oil to the various working parts, and it appeared to be very well considered. In this device pipes are led to every working part, the whole being under the control of the engineer. A register controls the distribution of oil in a most satisfactory manner.

SPECIAL SHOP TOOLS

came in for a good deal of consideration, and the committee which considered the subject were as follows: T. W. Gentry, Geo. L. Potter, H. D. Gordon, G. R. Joughins, Wm. Swanston, F. B. Miles. This committee made a very interesting report, which was substantially as follows:

Your committee were somewhat delayed and inconvenienced by the failure of members to fully understand the exact nature of the subject to be reported upon, many thinking that we desired to get information in regard to patented and manufactured devices only, and that the many handy and useful tools gotten up in their shops, were not to be included. Several members writing us that they had no tools, purchased, with a view of meeting special work, but had gotten up in their shops at different times many useful tools to meet certain classes of repairs on locomotives, but they did not suppose we wanted them, as they were of the opinion that all other shops had been driven by necessity to provide just such things; however, when we got it fully understood with them, we were very much pleased with the result. In this way we have succeeded in bringing out from under the work-benches and back corners of tool rooms, etc., a great many things of interest, a majority of which can be fitted up in any well-regulated shop at a nominal cost, and without having to order much, if any, new material, and certainly without having to make requisitions for new tools. Many of these devices are the result of bright mechanics and foremen being forced to accomplish much with small resources, others are the result of study on the part of mechanical engineers and draftsmen connected with repair shops, with a view of meeting otherwise difficult jobs with dispatch and economy.

In collecting the data for this report, we have been careful to get the views and opinions of members as to the introduction of improved methods and an interchange of ideas, with a view of having all the members of our association profit by the work of this committee. We are much pleased with the result, and though we were aware that many useful devices existed, but that many of them were almost hidden, as it were, and seldom shown to visitors, because of their rather homely appearance, or from the fact that their owners thought that everybody had something like it or better, but we had no idea of getting so many prints, drawings and sketches of useful appliances from members of our association, and it is more than gratifying to us, and should be to all our members, to learn that so much attention has been given to this subject in our repair shops all over the country.

We find that while very few attempts have been made at utilizing electricity by our members as a motor or means of supplying power to special tools, they have nearly one and all recognized the great advantages derived from compressed air, an element that most every one of them has right at hand, and that can be accumulated and conducted so easily, safely and cheaply.

Many have also taken advantage of hydraulics, and by simple and cheap methods have made plants of very considerable proportions with which much of their work heretofore accomplished at much expense for labor, has been greatly cheapened, and the length of time required to do certain work reduced over two thirds; this is particularly applicable to heavy hoists and for drop pits in handling wheels under engines in round house repairs, etc.

It was impossible for us to arrange for exhibition at this meeting the large number of prints, drawings, sketches, etc., sent in by members, and we have therefore included in this report complete lists of the more important devices, giving their names and the use for which they have been specially devised, and the name and address of the member in whose shops they are working, and instead of those interested having to hurriedly glance over the prints, etc., with abbreviated notes attached, they can select at their leisure from the list, such as may be of most service to them, and write the member, getting prints and full information, your committee having prepared for this by acknowledging receipt, and earnestly requesting all the contributors to preserve their tracings, drawings and sketches with this in view.

The experience gained by your committee in following their subject enables them to make some suggestions, which we hope may be kindly considered, and while most of our members being familiar with, may have taken advantage of them already, there are no doubt large numbers who have not done so because their shops are small and means limited, and while standing more in need of cheap and simple means of getting out an increased amount of work than many others better provided, they hold back on account of small expense to be incurred or because they are afraid it will not pay in small shops and for other reasons, none of which your committee think will hold good.

We find much attention has been paid to the working of portable universal drilling and boring machines; they are, in fact, indispensable in the larger shops, and in any shop that handles even a few modern engines a month, they can be made to pay largely. Some of our members have apparatus made by them, but there are on the market several excellent portable drilling devices, some operated by power from the shop shafting, in shape of ropes, sheave pulleys, flexible shafts, etc., others driven by steam or compressed air. It is found that new locomotive cylinders can be drilled and reamed in the floor near where they are to be applied, faster and more accurately with a good portable device than with most radial drill presses, and the heavy castings do not have to be moved as often as if under the drill press; all the heavy reaming for repairs, drilling out and renewing stay bolts, tapping stay bolt holes, and many other jobs formerly done by hand. The means of conveying power to these drilling machines can also be utilized for cylinder bores, valve seats, planers, etc., and where ropes and sheaves are used in connection with suitable snatch blocks or "turn abouts" the power can be conveyed to any desired point. Your committee recommend their adoption as a labor and time-saving device and find that they are not as generally known, and used, as their merits demand.

Your committee were pleased to find that the use of convenient hoists is more general than they had reason to expect, yet they are by no means as well introduced as their merits as labor-saving devices demand. With safe and convenient appliances for hoisting work at lathes, planers, drill presses, etc., a large amount can be saved not only in handling and chucking, but the machines themselves can be kept going more steadily and the risk of accidents to employes greatly lessened. We find compressed air is being used by a large number of our members for this purpose in connection with pneumatic cylinders of their own construction, which can be gotten up cheaply in any shop. Others, by constructing suitable overhead ways, use differential or safety chain hoists to great advantage and get all the necessary movement for taking work from floor, swinging it into position for chucking and handling, frequently dispensing with a helper or laborer at the machines. We find that some of our members have cheap and convenient cranes at their larger machines, constructed in the shops at odd times, to which are attached either pneumatic or chain hoists by which work, heretofore very costly to handle, is easily placed in position. These hoists are also used in erecting shops and in the yards for loading and unloading, and in many larger plants compressed air is used for raising cars, in removing trucks, applying wheels, etc. We strongly recommend the introduction of cheap and reliable hoists for general use at heavy machine tools, and members can get all necessary information from our list in regard to those in use in railroad shops, and we find there are quite a number of such appliances manufactured by the well-known makers of pneumatic, hydraulic and other forms of cranes and hoists, and there are several builders of machine tools and railroad shop specialties that make a cheap and reliable hoist. Members desiring to get full capacity of their machine tools and reduce liability of accidents to employes and save wages of helpers and laborers, should give this important item in shop practice the fullest consideration.

As before stated, your committee find that very little progress has been made in utilizing electricity in locomotive repair shops, and they are of the opinion that various causes will combine to prevent much being accomplished in this direction for quite a while yet; however, they feel that in view of the rapid strides made in applying this powerful element to heavy cranes, and for other purposes in the large building shops, more than a passing notice should be given it by members contemplating the erection of new shops or an extension on a large scale of present shops. The possibilities of a good electric plant in connection with large locomotive and car shops are, in our opinion, very great; in addition to its use as motive power for cranes, transfer tables, turntables, etc., may be considered a means of lighting buildings and yards, welding, brazing, and perhaps other uses suggesting themselves as necessity occurs. A lack of familiarity with comparative cost of erecting and maintaining such a plant as compared with other and better known methods, prevents our touching further on this subject, and we leave it for the consideration of all interested.

Among special shop tools that are not very generally used, mostly because their value is either underestimated or their better qualities little understood, are the best designs of patented small lathe tools. We refer to those tools so made, tempered and set in stocks or holders as to prevent the necessity of dressing and shaping, but that always present a proper cutting edge by grinding the dulled point only. Such tools are cheap compared to the immense quantities of high priced tool steel cut up monthly for small lathes, those for threading, cutting-off and light inside boring being especially handy and economical and insuring good work, while the more substantial, such as diamond points, round nose, square, etc., save time at light machines; this is particularly true of small lathes in tool rooms. We do not recommend these tools

for heavy work on any class of machines. The small tool departments of a few of the best special tool-makers can give some interesting information in regard to such tools, and no doubt some of our members can. We are aware that the market contains a number of them that are almost worthless; but there are good ones to be had.

Another class of shop tools that can be gotten up in any shop, but which we find are not generally in use, are the holding bars, or stocks, made to fit tool-posts of large engine lathes, and even wheel lathes, as well as planers, slotters, etc., and so arranged with suitable slots and set-screws for taking short bits or tools of square tool steel of proper size for work in hand; in this way the very best quality of tool steel may be used at a small cost, and the tools are more handy and can be kept in better shape with less work than if dressed on large pieces of heavy steel. These holding bars or stocks can be bent or set at any desired angle, and easily arranged so bits or tools can be worked up to points required, and when necessary the bits themselves can be offset or bent. For heavy inside boring and many jobs of turning, they are more steady and work better than solid heavy tools. Where slot in tool-post of heavy lathes is small it is best to have special tool-post with large slot for the tool holding bars. A tool holder of this kind is used to great advantage in upright slotting machines, and can be provided with clearance for the up-stroke by simple spring arrangement, thus saving the cutting tool from being broken or worn on point. The shank or stock of such bars is round, and held between two half-round clamps in tool-post, and can be turned in any direction desired in the post, so as to allow a rounded diamond-point tool to do almost any kind of work. Our lists show that these tools are extensively used in a number of shops, which can furnish desired information. A feature of this particular bar is that it allows the very shortest or worn out tools of best grades of steel from lathes to be made into a first class slotting tool, instead of the very heavy tools generally used.

We find the matter of convenient and accurate lathe mandrels has not received the attention it should in most repair shops, and instead of the gradual introduction of good "expanding" mandrels a majority of shops are still depending on the old solid mandrel in its most temporary form, and some shops have a ton of them which if put at their actual cost would purchase a full set of the best expanding mandrels, and if sold for No. 1 wrought scrap, would go far towards the cost of enough of them to take the place of about all their old mandrels. Since a number of our members have called attention to an expanding lathe mandrel in daily use by them and recommend it so highly, and from the fact that a reliable tool of this kind is difficult to obtain at reasonable prices, and many of our members having experience with some very poor devices of this sort, your committee have decided to mention the "Nicholson Expanding Lathe Mandrel" as probably the best of which they have knowledge, and as having been mentioned by all members who touched on this subject in their contributions to the committee work.

We desire to impress upon our members the advantages to be obtained in looking carefully around and corresponding with fellow members when they are selecting shop tools with a view of getting what are really "special shop tools." There are several builders of good heavy shop tools that make few, if any specialties, and, at the same time, there are many parties making strictly special tools, who make few, if any regular heavy machine tools. Some of the very best special shop tools are made by parties not as well known as the old standard machine tool-makers; this is particularly applicable to turret lathes, universal and plain milling machines, grinding and polishing machines, bolt heading and threading machines, punching machines, tube or flue welding machines, and many others that should be specially selected, and not included in contracts for shop plants, with a view of trying to procure from one or even two parties all the machine tools required.

Among the most useful of the special tools above mentioned, we would suggest that the possibilities of well designed heavy turret lathes, and heavy universal milling machines and punching machines, designed to meet the requirements of heavy locomotive shop repairs, make them the most important special machine tools to be considered in equipping a shop. We mention the punching machine particularly, from the fact that we find it is not as generally used as it should be in repair shops; with a proper punch and accurate templates, about two thirds of the rough drilling in car repair, and about all in tender and tank work, and very much bridge, roadway and miscellaneous work now drilled in many shops, can be punched at great saving in time, and allow use of drill presses for needed work that cannot be punched.

The rapid introduction of self or air hardening tool steel has caused the retirement of the old-style grindstone as a means of sharpening large machine tool cutters, etc., and the substitution of heavy tannite and emery grinders has proven wherever tried a paying investment, those styles of grinders designed to use water plentifully on the wheel have shown their superiority over the dry wheels.

There is a very convenient double form of these grinders with one coarse and one fine grained wheel set in same frame, and it is found that the smallest tools can be finely ground without injury to temper. We suggest to those of our members who have never used them, to inquire into their merits as compared to old style grinstones.

In conclusion, your committee want to forcibly impress each member with the importance of a "tool room" and tool keeper. In our opinion, no shop, however small, can afford to be without a tool room, if it is nothing but a corner railed off in the shop and looked after by the foreman. We find most shops of consequence have tool rooms, many of them very elaborate arrangements, for making, repairing, and caring for tools. We find that any shop employing as many as a dozen machinists can well afford to establish a tool room, and select a good man who has qualifications for this work, whose duty it should be to look after and keep small tools in order, and keep all drills, cutters, reamers, etc., ground ready for immediate use; such tools should not be altered, or even sharpened outside of the tool room. Members wanting information in regard to tool rooms and methods of checking for tools, etc., can get the same from most any member whose name is given on the list accompanying this report.

MANUFACTURES

The Charleston (N. C.) Lead Works will add a building to its plant.

The Ohio R. R. Co. will build machine shops in Henderson, Ky.

Begiebing & Butell of Des Moines, Iowa, are erecting additions to their plant.

The Fredericksburg (Va.) Wheel Works are erecting an addition to its plant.

Steele Bros., of Slaterville, W. Va., are adding machinery to their machine shops.

The Addyston Pipe and Steel Works, of Addytson, O., will build an addition to its plant.

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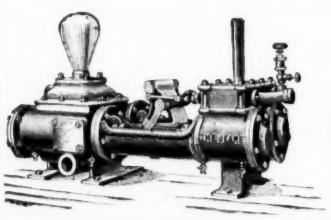
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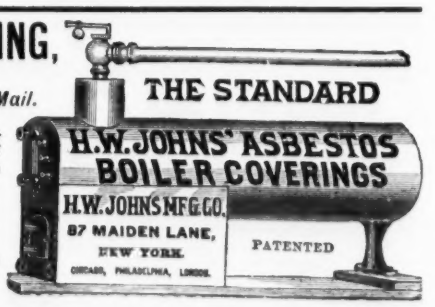


The Marshallton, Del., Iron Co., is adding more men to its working forces.

The works of the Racine (Wis.) Iron Co., have been rebuilt on another site.

The Woodstock Iron Co. at Anniston, Ala., is getting its furnaces ready to start.

The Ball Mill of the Cambria Iron Co., Johnstown, Pa., has been put on double-turn.

An addition is being built to the Kalamazoo (Mich.) Foundry and Machine Co.

The Casey Nail Co., Lewiston, Me., will, this summer, erect a large addition to its plant.

The Holyoke (Mass.) Calender Roll Co. has been organized and expects to be in operation in July.

Building operations on the plant at North Tonawanda, of Plumb, Burdict & Barnard, of Buffalo, N. Y., have commenced.

The Baltimore (Md.) Machine Heating Co. has been organized to make steam-heating apparatus. John J. Kelly and others are incorporators.

The Springfield (O.) Machine Tool Co. inform us that they are now preparing to make a line of engine lathes from 18 inches to 24 inches swing.

The New Home Sewing Machine Co., Orange, Mass., is now running its factory full force five days a week, and much of the force full time.

The W. Dewees Wood Company, of McKeesport, Pa., has put on several additional departments, giving employment to quite a number of men.

There has been incorporated the Meteor Cycle Co., with capital of $35,000, in Battle Creek, Mich. A plant will be erected. W. C. Smith is connected.

The New National Time Recorder Co. has been organized in Milwaukee, Wis., and will manufacture automatic time recorders. Capital, $30,000. President, Frank Bolte.

There has been incorporated in Boyertown, Pa., the Union Mfg. Co., for the manufacture of iron and steel. Among the incorporators are: John Sabold and Thomas J. B. Rhoades.

An additional mill will be put in operation soon at the Ellwood Tin-plate Company's plant, at Ellwood, Pa., and the force increased from 150 to 200 men. Orders are coming in well.

A company has been organized to build black-plate mills at Cambridge, O. Local capitalists will furnish the means, and Ambrose Beard, New Philadelphia, O., will be general manager

The Penn Engineering Co. has been formed in Philadelphia, Pa., and will erect a plant in which to make heating apparatus. Capital, $30,000. Incorporators, W. M. Brownback and others.

The Lalance & Grosjean Co., Harrisburg, Pa., will shortly begin the erection of a large tin-plate mill, 75x200 feet. It is expected the new mill will be in operation by September 1st, with 75 employes.

The Pottsville Iron and Steel Co., Pottsville, Pa., is using the Archer gas machine with petroleum in its open-hearth furnaces. The company states that the service secured is fully equal to that from coal.

The Metropolitan Electric Co., at Reading, Pa., are putting up a new power house, and have placed the contract for the iron roof and traveling crane with the Berlin Iron Bridge Co., of East Berlin, Conn.

The Rogers Manufacturing Company, makers of bone goods at Rockfall, Mass., whose factory was burned some weeks ago, have decided to rebuild on the old site. They expect to resume manufacturing in about four months.

A new saw and planing mill, at Springfield, Mass., belonging to Charles Plumley & Son, was recently destroyed by fire, together with valuable machinery and 400 finished boxes. The machinery and engine are practically ruined.

An unusual record of activity is that of the New Castle (Pa.) Wire Nail Works, which have worked steadily for nine months without losing a turn day or night. Between 3,000 and 4,000 kegs are turned out every twenty-four hours.

Work on the Whittaker mill at Wheeling, W. Va., is progressing rapidly. The Schiffler Bridge Co., of Pittsburgh, is engaged in the work of construction, and is now employing about fifty hands. The mill will be 600 feet long and 100 feet wide

The Boston & Albany railroad management has completed plans for the erection of a new plant of car shops in West Springfield, Mass. The present shops are outworn and outgrown, and the new plant will be larger, and equipped with the latest and best machinery.

There has been a general resumption of work recently at the plant of the Pennsylvania Steel Co., Steelton, Pa., with encouraging prospects of work all summer. Two large blast furnaces are now in operation, and another will be blown in as soon as the supply of coke can be secured.

The Illinois Steel Company has seven furnaces in blast, one on foundry iron at Bay View, Wis., one on Bessemer at Joliet, and four on Bessemer, and one on special at South Chicago. Preparations are being made to put one of the North Chicago furnaces in blast as soon as the coal strike is settled.

The Electro Chemical Co., organized at Portland, Me., for the purpose of carrying on chemical, electrical and manufacturing business, filed a certificate June 1st. The capital stock is $800,000, of which $600 is paid in. George Snider, of Newton, Mass., is president, and William J. Spaulding, of Boston, is treasurer.

The W. & S. Hydraulic Machinery Works (Watson & Stillman, proprietors), of New York, inform us that they are now working full force and full time, on their line of hydraulic specialties for a great variety of purposes. An order now being filled is for presses to squeeze oil from fish, which they are building to go to Norway.

A large plant will be erected in Providence, R. I., by the Burdon Seamless Filled Wire Co. The building is to be of "skeleton steel" construction, faced with brick, and will be 525x40 feet, six stories. Electric power will be employed. The power house will be of two stories, containing in addition to the engines, boilers, generating plants, etc., a repair and store room.

It is practically assured that there will be a large machine shop and foundry built the present summer on the Fairfield road, near the Purington brickyard, in Waterville, Me. The necessary stock is all pledged and the work will probably be commenced at an early date. The industry will be quite an addition to the business of the city, as it will give employment to at least 150 hands.

The Ætna-Standard Iron and Steel Company, of Bridgeport, O., has two mills in operation making black plate. The company will not be prepared to coat sheets before July 1st, at which time it expects to make both bright and terne plates. They have three sets, two for tin plates and one for terne plates, and the estimated weekly capacity is 600 boxes of tin plates and 300 boxes of terne plates.

N. M. Neal, formerly agent of the Auburn Foundry Company, has leased a lot of land in Auburn, Me., and contemplates building a foundry there. The main building will be 40 by 0 feet and will have a steel roof. Two other buildings will be erected, to be used in connection with the large one. The work of building will be commenced immediately. Mr. Neal understands the foundry business thoroughly and will be successful in this enterprise.

The Baltimore Iron, Steel and Tin-plate Company have concentrated their operations at Locust Point, securing a lease for three years on the plant of the old Coates rolling-mills, at that place, with the option of purchase. Among the incorporators of the company are E. K. Rice, Daniel and Robert Girvin, of Swansea, Wales. The officers are James E. Ingram, president; John M. Ingram, secretary, and Robert Girvin, treasurer and general manager.

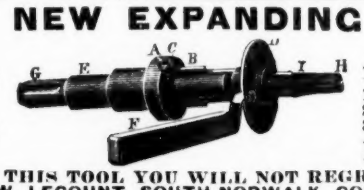
The Great Barrington (Mass.) Electric Light Company has entered into an agreement with the Monument Mills Company, at Housatonic, for a lease of the water power and electric-light station of that company, including all the electrical generating machinery, and arrangements will at once be made for lighting the village of Great Barrington from that station. This plant will do away with the old electric-light station in the village and its attendant noise.

Andy D. Howard & Co., of Bartow, Fla., write us: We are erecting foundry and machine shop at this place, to repair and build new phosphate machinery. We have ordered our tools from the New Haven Mfg. Co., New Haven, Conn. Our building is: 40x60 feet machine shop, 40x40 feet foundry, and 15x15 feet blacksmith shop. Will be in running order by 1st August. New Haven folks can't get our tools out before 1st July—suppose they are overrun with orders.

It is now definitely decided that the well-known Howard & Bullough American Machine Co., which is a branch of the same firm of Acrinton, Eng., will locate its works in Pawtucket, R. I. The location decided on is at Pleasant View, along the tracks of the Consolidated road on the Massachusetts State line. It will cover over forty acres of ground when completed, and will furnish employment to more than 1,000 hands. James C. Potter, of Pawtucket, and James Riley, of Boston, are the American directors of the company.

LECOUNT'S NEW EXPANDING MANDREL.

Amateur's Size.
Taking anything from ⅛ to 1 inch inclusive.
Price.....$5.00
Patented Dec. 25, 1877.



Machinist's Size.

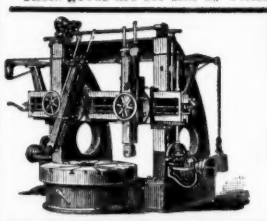
No.			Price.
1	⅛ to 1	in.	$10
2	1 "	1½ "	14
3	1½ "	2 "	18
4 (with screws)	2 "	3 "	32
5 "	3 "	4 "	44

IF YOU WILL TRY THIS TOOL YOU WILL NOT REGRET THE EXPENSE.
C. W. LECOUNT, SOUTH NORWALK, CONN.
SPECIAL MANDRELS FOR SPECIAL JOBS MADE TO ORDER.
These goods are for sale by CHAS. CHURCHILL & CO., L'td. 21 Cross St., London, England.

DON'T ACCEPT ANY SUBSTITUTE FILE.
INSIST ON HAVING NICHOLSON.

NICHOLSON FILE CO.
PROVIDENCE, R. I., U. S. A.

3000 VARIETIES FILES
[X. F.] & INCREMENT CUT FILES.



BORING AND TURNING MILLS
COMBINING EVERY IMPROVEMENT.
14 SIZES FROM 5 TO 20 FEET.
BETTS MACHINE COMPANY,
WILMINGTON, DEL.

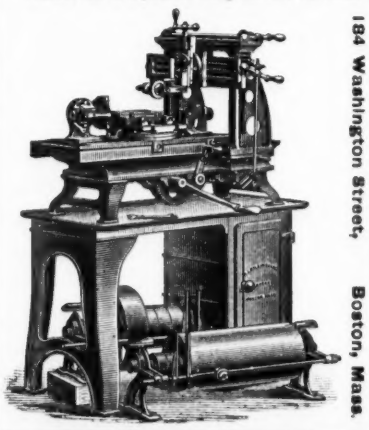
IF YOU HAVE ANY SMALL ARTICLES in Brass or Iron that you want manufactured in quantities, write to THE JONES BROS. ELECTRIC Co., 28-30-32 West Court St., Cincinnati, O.

JESSOP'S STEEL
FOR TOOLS, DRILLS, DIES, &c.
ALL KINDS IN STOCK.
Manufactory, SHEFFIELD, ENG.
Chief Am. Office, 91 JOHN ST., N. Y.
WM. JESSOP & SONS, LTD.
Established a century ago.
Medal World's Columbian Exposition 1893.

Over 12,000 in use.

"Columbia" Vernier Calipers, Etc.,
Are Highly ENDORSED and WORTH your CONSIDERATION. Send for Catalogue and Prices to
E. G. SMITH, Columbia, Pa.

POWER OR HAND PLANER,
FOR MODEL MAKERS, EXPERIMENTAL WORK, &c.
Has all the Improved Features Usually Found on High Grade Planers, and is Capable of Doing the Best and Finest Work.



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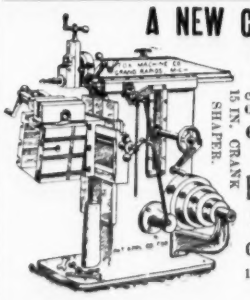
☞ Our New and Revised Catalogue of Practical and Scientific Books, 88 pages 8vo., and our other Catalogues and Circulars, the whole covering every branch of Science applied to the Arts, sent free and free of postage to any one in any part of the world who will furnish his address.

A NEW CRANK SHAPER.
NOVEL, YET SIMPLE.
Length of stroke changed INSTANTANEOUSLY while IN MOTION.
Get Photos & Prices.
NOTHING LIKE IT.
Fox Machine Co.,
325 Nor. Front St.,
Grand Rapids, Mich.
135 Finsbury Pavement, London, England.



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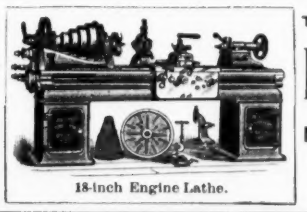
163 & 165 WASHINGTON ST.,
NEW YORK.
ENGINES and BOILERS.

VERTICAL,
HORIZONTAL,
STATIONARY,
PORTABLE,
Plain and Automatic.
Write for Catalogue and mention this paper.

FITCHBURG MACHINE WORKS,
MANUFACTURERS OF
FITCHBURG MODERN
AND OTHER
SEND FOR CATALOGUE E.

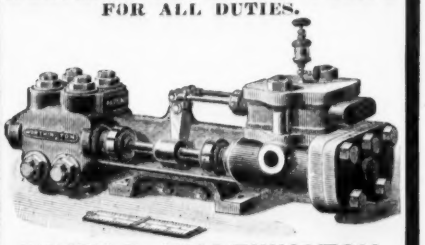

18-inch Engine Lathe.

THE CELEBRATED
ENGINE LATHE
METAL-WORKING MACHINES
FITCHBURG, MASS.

BUILDERS IRON FOUNDRY, Providence, R. I.
LARGE AND STRONG BRONZE CASTINGS.
45,000 lbs. Tensile Strength per sq. in. 15 per cent. Elongation
GUARANTEED.
As high as 68,000 lbs. Tensile Strength, and as much as 49 per cent. Elongation have been obtained.

VOLUNTARY TESTIMONY.
DOVER PLAINS, N. Y., May 21, 1894.
MESSRS. COOKE & CO.,
Gentlemen:—With pleasure I write you a few lines to let you know that I am well satisfied with the little Acme Blower and Tuyere I bought of you some time ago. I am using it here at Dover Plains alongside of a good big bellows; but the bellows is nowhere, big as it is. It can't begin to make such a fire as the little Acme Blower does. I can get any kind of a fire I want. It made a little noise at first and run a little hard, but I kept it well oiled inside, and now it almost runs itself. . . . .
Yours very respectfully,
EDWARD PEARN.
For Prices etc., of BLOWERS referred to in above letter, address
COOKE & CO.,
163 and 165 WASHINGTON ST.,
NEW YORK.
Agents for P. H. & F. M. ROOTS CO.

WORTHINGTON STEAM PUMPS
FOR ALL DUTIES.



HENRY R. WORTHINGTON,
NEW YORK, 86 and 88 Liberty St.
BOSTON, 70 Kilby St.
PHILADELPHIA, 607 Arch St.
CLEVELAND, 24 South Water St.
CHICAGO, 185 to 189 Van Buren St.
ST. LOUIS, Eighth and St. Charles Sts.

An air compressing machine that has been constructed and set up in the Oakland (Me.) Manufacturing Company's machine shop, and which is now furnishing the power by which the machinery of the shop is run, is attracting considerable attention. The machine is run by water-power. The power is transmitted by a chain running on a sprocket-wheel. The piston is connected with one of the links of the chain. The cylinders are 8 inches in diameter, and the stroke is 8 feet. The pressure can be adjusted as easily as steam, and the compressed air is more elastic than steam. Power can be transmitted through pipes for several miles, thus making it possible to utilize water-power at a distance. The engine is useful not only as furnishing power, but also for ventilation. The great pressure beats the cylinders to such a degree that it is necessary to keep them immersed in tanks of water. All this heat is lost in the sudden expansion of air at the vent, and the blast which issues from the end of the pipe is ice-cold. The machine is the invention of two men, one of whom, Ansel Swift, is now in Oakland, and superintended the setting up of this motor. It is owned by a stock company composed chiefly of Waterville men, among whom are Dr. Thayer, Colonel Bangs, W. T. Haines, and other well-known men of capital.—*Industrial Journal.*

Machinists' Supplies and Iron.

NEW YORK, June 23, 1894.

Iron—American Pig—We quote Standard Northern brands, No. 1 Foundry, $12.50 to $13.00; No. 2, $11.25 to $12.00; Gray Forge, $10.25 to $10.50. Southern brands are quoted at $11 50 to $12.25 for No. 1 Foundry; $10.50 to $11.00 for No. 2, and $10.00 to $10.25 for No. 3.

Antimony—The market is dull and weak. We quote L. X., 8⅞c. to 9c.; Cookson's 10c. to 10¼c.; Hallett's, 8.50c. to 8 60c., and U. S. French Star, 10c.

Lard Oil—Prime is quoted at 58c. to 60c.

Copper—The market is dull, but a better feeling prevails. Lake Copper is held at 9.15c. by the car load. Casting Copper is held at 8.65c. to 8.75c.

Lead—The market is quiet and nominal at 3.35c. for New York delivery. It is claimed that with the new tariff going into effect these prices will have to be abandoned, as imports can be made at or about 3 65c., based on prices as at present ruling abroad.

Spelter—The market is dull; car loads are quoted at 3.45c., but on account of the absence of important business, values are more or less nominal.

Tin—Buyers are restricting wants to actual necessities; at present prices are steady at 19.65c.; there seems to be little confidence in the tin market on account of the tariff question.

✲ WANTED ✲

"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Wanted—By a first-class machinist and draftsman, a position. Box 110, AMERICAN MACHINIST.

An exp'd designer and draftsman on fine mach'y, wants a position. Box 113, AM. MACHINIST

Molder wants position, well up on heavy engine and general jobbing work in dry, green, or loam; good refs. Box 108, AMERICAN MACHINIST.

Wanted—A master mechanic to take entire charge of shops employing 250 men; must have wide experience. Box 109, AMERICAN MACHINIST.

Machinist, 30, wants pos. as foreman or instructor in college or trade school; best of refs. from former position. "Instructor," AM. MACHINIST.

Wanted—An experienced man who thoroughly understands operating gear-cutting machinery of all kinds. Address Box 111, AMERICAN MACHINIST.

Draftsman of an eng. and boiler work, wants a change; graduate 7 years' exp.; some exp. in designing and estimating. Box 112, AM. MACHINIST.

A mech. engineer with experience in designing machinery and in handling men, desires a position. Address O. Hi O., AMERICAN MACHINIST.

Wanted—An assistant draftsman accustomed to locomotive work; none other need apply. Apply by letter to John Rohland, care the Coxe Iron Mfg. Co., Drifton, Luzerne Co., Pa.

Wanted—Foreman machinist and toolmaker for a shop building hoisting engines and heavy mach'y; state exp. and salary required; incompetent men need not apply. Address F. F., care AM. MACH.

An exp'd mechanic and designer of special tools, etc., desires a position as general foreman or assistant superintendent in a bicycle works. Address Box 114, AMERICAN MACHINIST.

An expert engineer, one who keeps own steam indicator and who is capable of doing his own repairs, desires a first-class position; references A1. Address Samuel Andrews, care Dickerson's News Room, Hartford, Conn.

Mech. & hydraulic eng., who has his own design for turbines, giving high efficiency at part gate, wants pos. with firm willing to build them; has graduated in civil eng. at European college; 16 years' in the trade. Successful, AM. MACHINIST.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 25 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Best Steel Flue Scrapers. Kelley Co., Erie, Pa.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Wanted—To buy good second-hand tools. Box 83, AMERICAN MACHINIST.

Mech. eng'r, will translate at reasonable rates catalogues and specifications, English, French and Spanish. Address T., Box 133, Yonkers, N. Y.

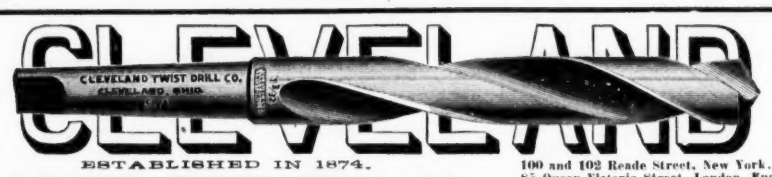
Wanted—Makers to deliver machines for liquorice manufactory. Prepaid offers to R. A. 6863, care G. L. Daube & Co., at Cologne, Germany.

Introduction and negotiation of American patents and machinery to English manufacturers and agents. Write for circular to Geo. Richards, M. I. M. E., Mechanical and Consulting Engineer, No. 5 Laurence Pountney Hill, London, England.

Do you want a picture of the famous Locomotive "999?" Send 50 cents for our fine copper plate *transparent* picture (11x28), showing all parts *inside* and *outside*, all named and numbered, on satin gloss paper, for framing, educational, beautiful, correct. Locomotive Engineering, 256 B'way, N.Y.

Information Wanted—Advertiser is a 1st-class tool maker, die maker, and expert machinist. Also a good d'tsman and designer of mach'y. Is seeking location to establish a small jobbing machine shop where there is reasonable prospect of success. Information acknowledged with grateful thanks. All letters answered. Wm. E. Piper, 7639 Drexel Ave., Chicago.

An engineer's widow has a comp'ete set of back volumes of the AMERICAN MACHINIST since 1881, which she wishes to sell, together with paid-up subscription to AMERICAN MACHINIST, for $20. Some of the volumes are bound and some unbound, but every number is in perfect condition. Address Mrs. O. A Lanphear. 967 Dennision Ave., Columbus, O.



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ESTABLISHED IN 1874.

CLEVELAND TWIST DRILL CO.

100 and 102 Reade Street, New York.
85 Queen Victoria Street, London, Eng.
5 Neue Promenade, Berlin, C., Germany.
Cor. Lake and Kirtland Streets, Cleveland, O.

Lathes, Planers, Drills, Shapers,

Boiler Tools, Steam Hammers, etc.

Now remaining unsold in the Engine and Boiler Shop, will be closed out at once.

IRON PLANERS.

19 in. x 3 ft. Wheeler.
20 " x 4 " Lathe & Morse.
24 " x 4 " Blaisdell
24 " x 5 " New Haven.
24 " x 6 " Powell "Latest."
26 " x 7 " N. Y. S. Eng. Co
26 " x 8 " Pease.
30 " x 10 " Pease
32 " x 6 " Wood Light.
36 " x 10 " Gleason.
60 " x 24 " Heavy Pattern.

SHAPERS.

6 in. Stroke, Crank.
8 " " Gould.
9 " " Hewes & Phil.
15 " " Hendey.
16 " " Gould & Eber.
22 " " Triple Geared.

DRILLS.

22 in. Swing Prentice.
26 " " Lodge & Davis.
26 " " Prentice Friction.
36 " " Cintl. complete
48 " " Old Style.
Radial Drill 86 in. complete.

MILLING MACHINES.

B & S. No. 1 Universal with Cutters, Arbors, &c. A1 order
Garvin No. 3 Bk Gears auto fd.
Cincinnati No 2 Bk. Gs. auto. fd.
Pratt & Whitney, "Lincoln."

ENGINE LATHES.

11 in x 5 ft. Phila.
13 " x 6 " Blaisdell.
14 " x 6 " Reed.
16 " x 6 " New Haven.
16 " x 6 and 8 ft., Ames.
18 " x 8 ft. Putnam.
20 " x 10 " Fitchburg.
24 " x 7 " Otis
24 " x 12 " Putnam.
30 " x 10 " Prentiss, Taper.
32 " x 16 " Gleason.
35 " x 15 " Hewes & Phillips.
36 " x 18 " Improved Style.
48 " x 17 " Hewes & Phillips.
84 " x 18 " Lincoln.
Pit Lathe, 72 in.

HAMMERS.

50 lb. Helve, Bradley, Up'g't.
300 " Steam, Ferris & Miles.
800 " " " "
1200 " Drop with Lifter, Farrel F'd'y's Make.

BOILER TOOLS.

Rolls, 6, 8 and 10½ ft.
Boiler Shears, 30 in. gap.
Flange Clamps, 6 ft.

MISCELLANEOUS.

Acme, 3½ in. Bolt Cutter.
Bor and Turn. Mill, 38 in.
Vert. Turret Borer, B. & S.
Slotter, 10 in. Stroke.

J. J. McCABE,

SUCCESSOR TO
E. P. BULLARD'S
N. Y. Mach'y Warerooms.

14 Dey St.,
NEW YORK.

BARGAINS IN SECOND-HAND MACHINERY.

ENGINE LATHES.

1 12 in. x 5 ft. Geo. Gage.
1 14 " x 6 " Bogart.
1 15 " x 8 " Fitchburg.
1 16 " x 6 " Perkins.
1 16 " x 7 " Bement.
1 16 " x 6 " F. E. Reed.
1 18 " x 6 " New Haven.
1 18 " x 8 " Pease.
1 20 " x 6 " Bullard.
1 29 " x 12 " Fifield.
1 37 " x 14 " Old Style.

PLANERS.

1 16 in. x 16 in. x 3 ft. Belden.
1 22 " x 22 " x 4 " L.W.Pond
1 24 " x 24 " x 6 " Novelty Iron Works
1 24 in. x 24 in. x 10 ft. Pease Planer Co.
1 28 in. x 28 in. x 7 ft. N. Haven.

SHAPERS.

1 6 in. Boynton & Plummer.
2 10 " Juengst Crank.
2 10 " Wood and Light Traverse head.
1 15 in Juengst Friction.
1 18 " Putnam Traverse head.

DRILL PRESSES.

2 10 in. Milliken Bench.
1 10 " Gardam Sensitive.
1 10 " Three Spindle Slate.
1 No. 1 Two Spindle Garvin.
1 " 2 Three " "
2 " 3 Four " "
1 " 3 Six " "
1 5 ft. Niles Radial.
1 5 " McNaull Universal Radial.
1 7 " Alfred Box Universal Radial.
1 9 ft. Holly Mfg. Co. Radial.

SCREW MACHINES.

1 No. 5 Brown & Sharpe.
1 " 2 " "
1 " 3 Windsor Machine Co.
1 " 2½ Pratt & Whitney.
1 16 in. x 5 ft. Flather & Co.
1 18 " x 6 " Hendey Mach. Co.

MILLING MACHINES.

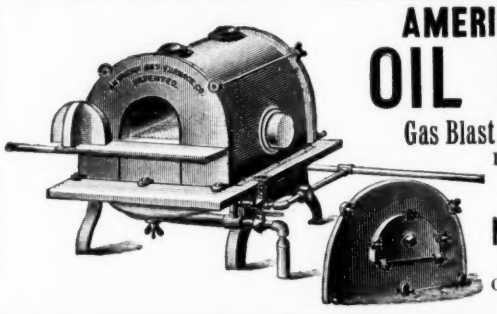
1 No. 2 Garvin Hand.
1 " 1½ Garvin, Power.
1 " 2 Garvin, Power.
1 " 0 Garvin, Universal.
1 " 5 Brainard Standard.
3 " 2 Garvin Lincoln.
1 " 4 Garvin Rack Feed.
1 Garvin Heavy Slab Miller.

Also, a large number of other machines. Write for complete list and detailed description.

THE GARVIN MACHINE CO.,
LAIGHT & CANAL STS., NEW YORK
Also 51 North 7th St., Philadelphia, Pa.

NEW BENCH DRILL.

Flat Belt, Rack and Pinion Feed.
(Write for Circular.)
D'AMOUR & LITTLEDALE, 204 E. 43d St., New York.



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OIL GAS PLANTS

Gas Blast Furnaces & High Pressure Blowers

For the economical generation and systematic application of HEAT.

CATALOGUES ON APPLICATION.

No. 80 Nassau St., - NEW YORK.

ENGLISH AGENCY:
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DETROIT TWIST DRILL CO., DETROIT, MICH., U. S. A.

SOLE MANUFACTURERS OF

GRAHAM'S GROOVED SHANK TWIST DRILLS AND CHUCKS.

Endorsed by Practical Mechanics Everywhere. Send for Catalogue.

We have Removed our Office

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AND

86 LIBERTY ST.,

NEW YORK.

Shall be pleased to have our Customers call and see us in our new quarters, when in the City.

SEND FOR OUR LATEST LIST.

Telephone 874 A Cortlandt.

GEORGE PLACE MACHINE CO.

SECOND-HAND MACHINE TOOLS

FOR SALE AT LOW PRICES.

50 Driving Wheel Lathe. N. Y. S. E. Co.'s make. *Fair order.*
36" x 36" x 10' Sellers Planer, single head. *Good order.*
34" x 8½' Putnam Engine Lathe, rod feed, screw and compound rest. *Good order.*
26" x 8' Pratt & Whitney Chucking Machine. *Very good order.*
12" x 4' Pratt & Whitney Engine Lathe, with taper attachment.
1 Pratt & Whitney "Grant Pattern," Double Column, Double Head Milling Machine. *Good as new.*
2 22' Pratt & Whitney Manufacturers' Drills, with two-spindle attachment. *Good order.*

E. P. BULLARD,

145 BROADWAY (Room 6), NEW YORK.

BRIDGEPORT MACHINE TOOL WORKS, BRIDGEPORT, CONN.

BLAKE & JOHNSON,

WATERBURY, CONN.

Builders of WIRE FORMING MACHINES

With F. B. Manville's Patent Sliding Former,

For making articles from the coil, of either round, half round, flat, or square wire, similar in shape to those shown in the cut herewith. Also similar articles made to order.

Send samples of articles required, and mention quantity wanted, that we may quote prices for either machine or the goods, whichever may be desired.

☞ Bicycle and Labor Saving Machinery a Specialty.

IF YOU WANT ANYTHING IN THE LINE OF
DROP PRESSES · DROP HAMMERS · STAMPS
OR AUTOMATIC DROP LIFTERS ·
SEND FOR CATALOGUE TO
MINER & PECK MFG. CO.
NEW HAVEN, CONN.
LARGEST LINE IN MARKET.

BRASS-WORKING TOOLS.

SPECIAL MACHINERY.

BARDONS & OLIVER
Cleveland, Ohio.

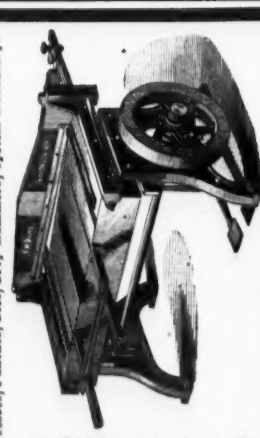
PRICES ON APPLICATION.

SCREW MACHINES.

E. W. BLISS CO.,

1 ADAMS ST., BROOKLYN, N. Y.

Presses, Punches, Dies, Drop Hammers, Special Machinery.



THE STILES & PARKER PRESS CO.

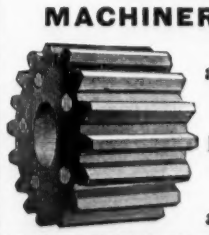
Chicago Office, 100 W. Washington St.

STRANGE, BUT TRUE!!

THE NEW PROCESS RAW HIDE GEARS

ASTONISH THE

MACHINERY WORLD.



They Outwear any Metal.

They require No Lubricant.

They are Noiseless and Clean.

NEW PROCESS RAW HIDE CO.,

PATENTEES AND SOLE MANUFACTURERS,

SYRACUSE, N. Y., U. S. A.

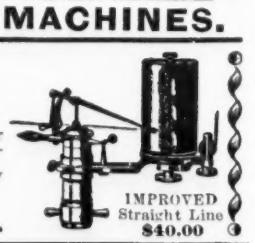
ROBERTSON THOMPSON
$40.00

Y SHOULD U PAY

$85.00 for an Indicator when you can get either of these for $40.00, packed in finest cases, finest workmanship, finest material, and the **best** designs.

Send for circular of Reducing Wheels, Planimeters, Three-Way Cocks and 25 other high grade specialties.

HINE & ROBERTSON CO.,
61 Cortlandt St., New York.



IMPROVED Straight Line
$40.00

THE CLEVELAND MACHINE SCREW CO.,

CLEVELAND, OHIO.

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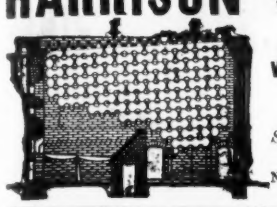

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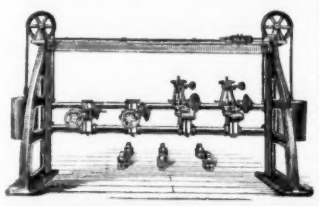

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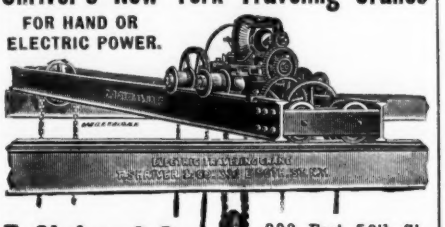

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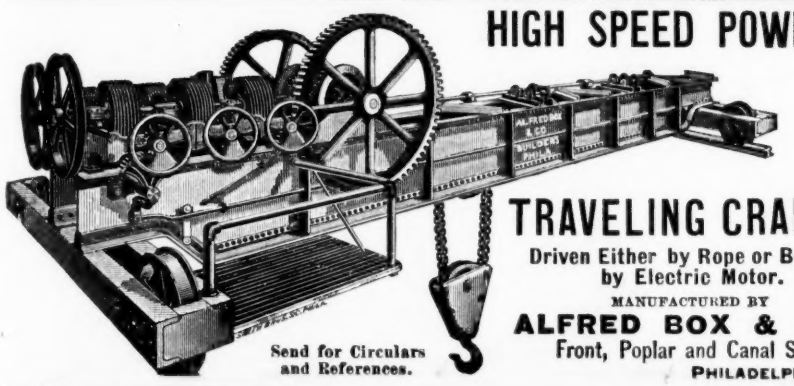

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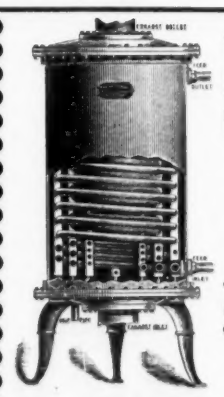

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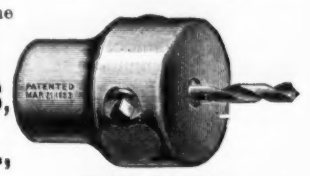

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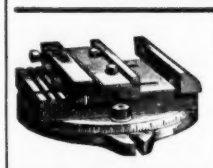

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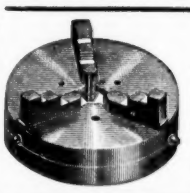

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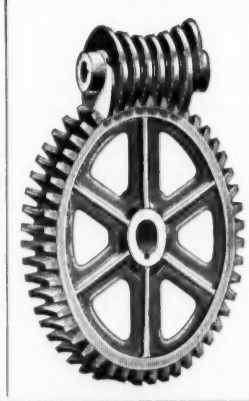

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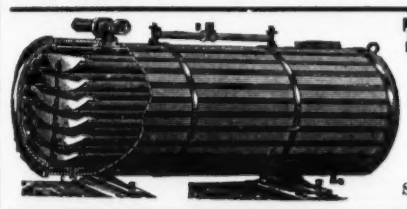

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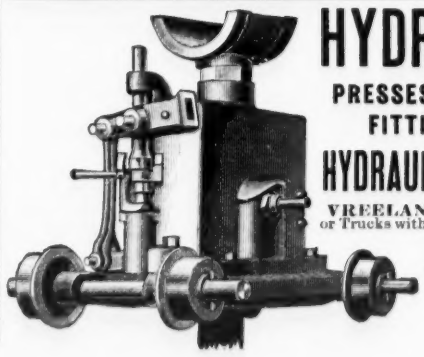

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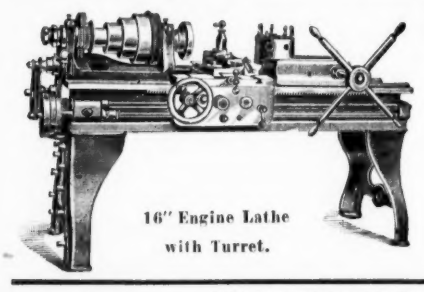
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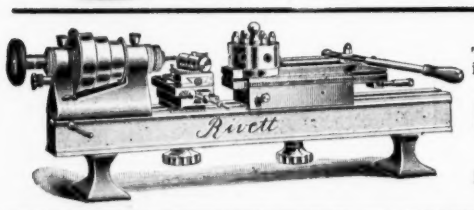

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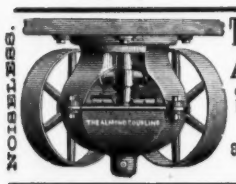

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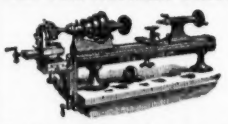

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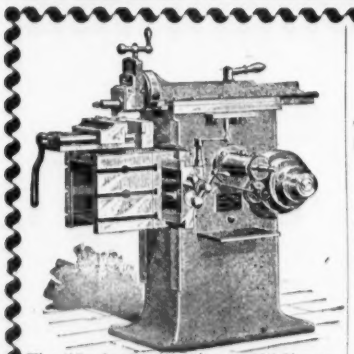
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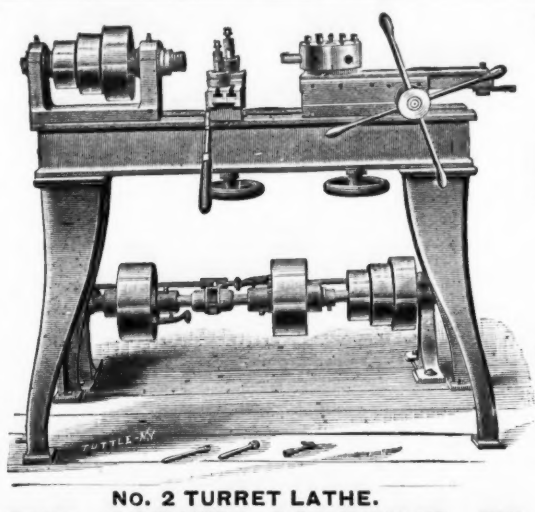
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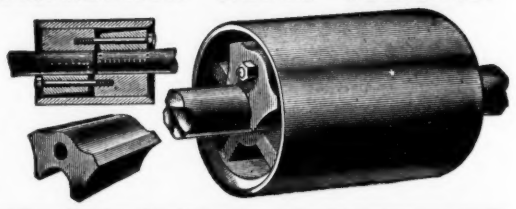

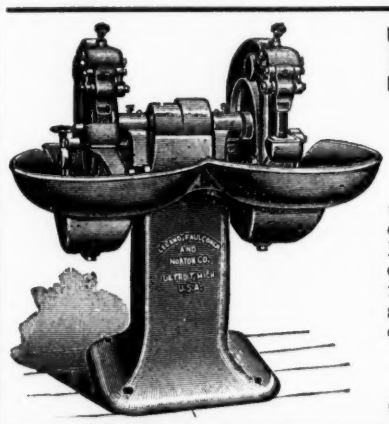

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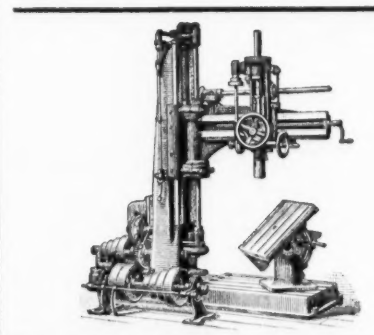
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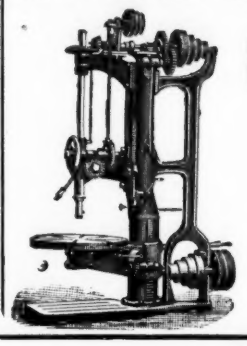

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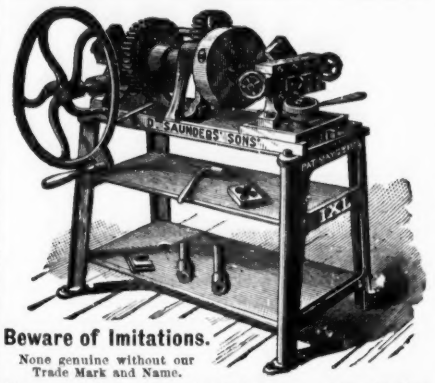

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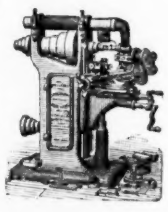

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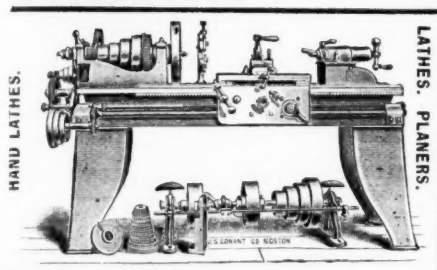

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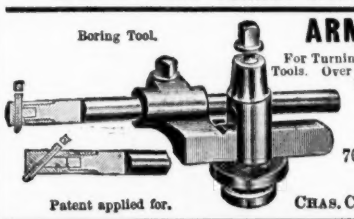

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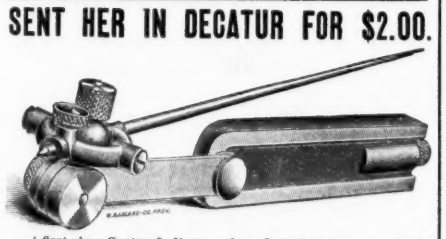

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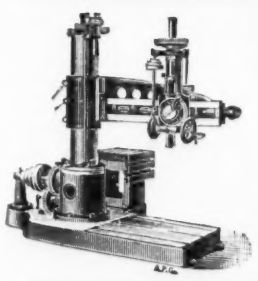

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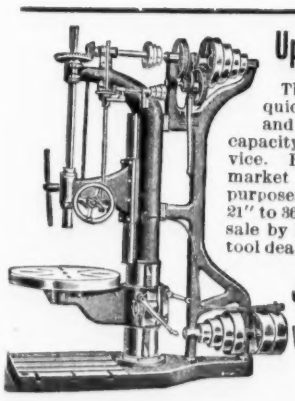

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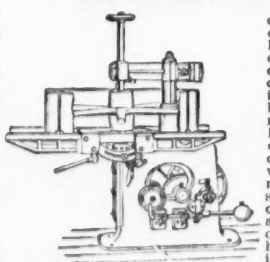

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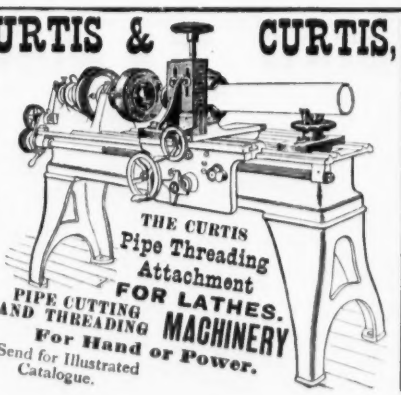

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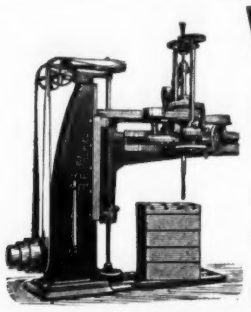

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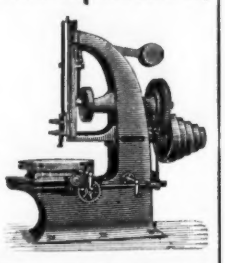

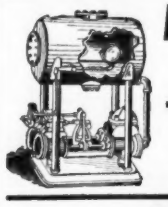

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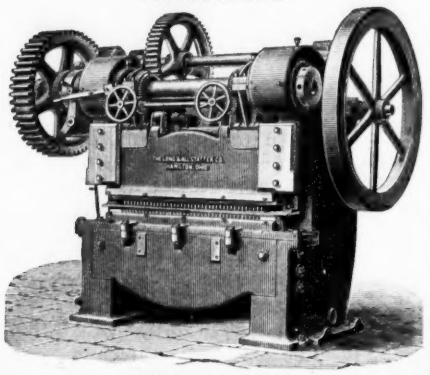

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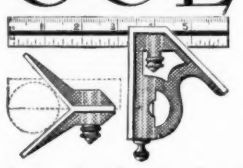

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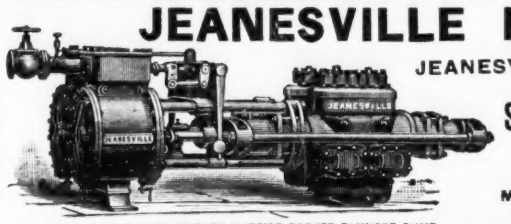

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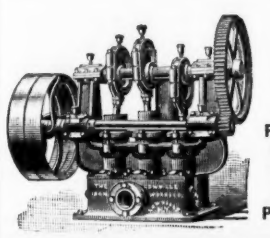

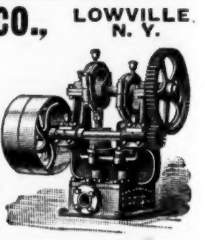

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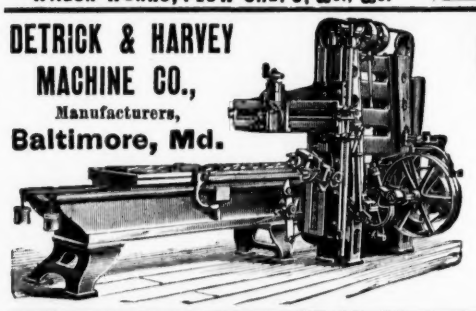

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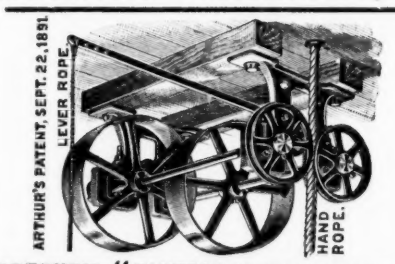

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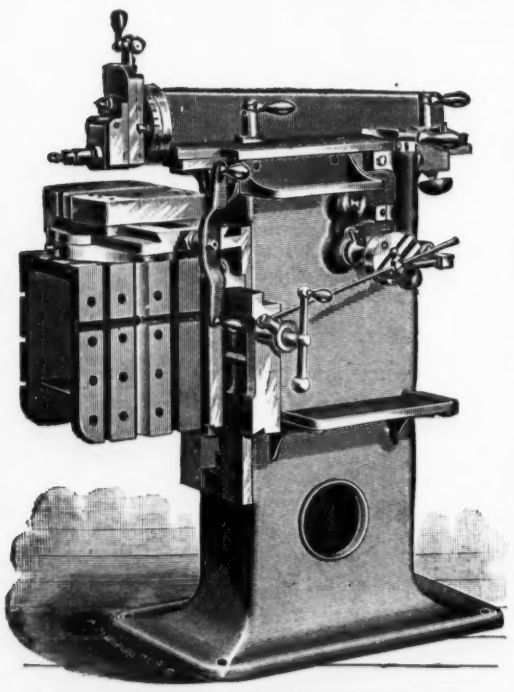

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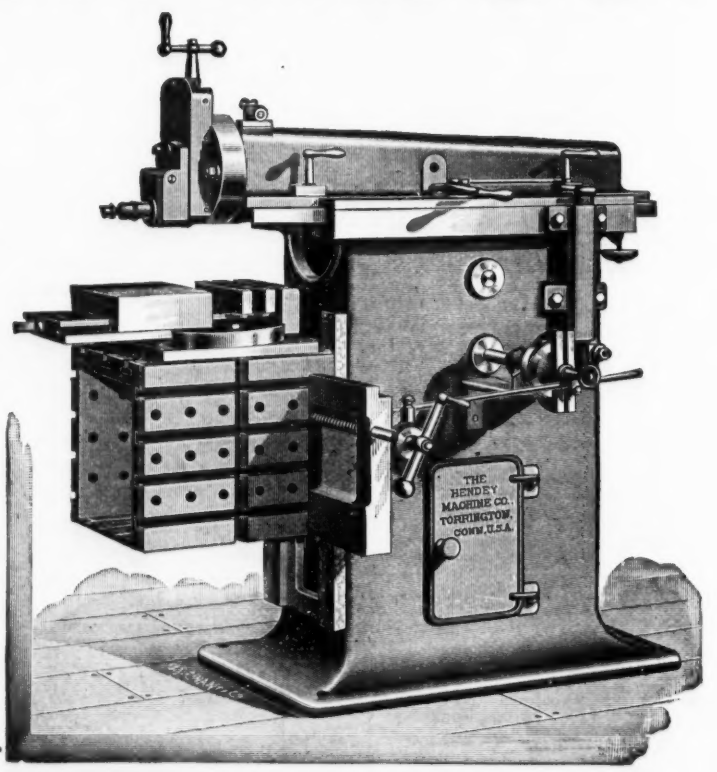

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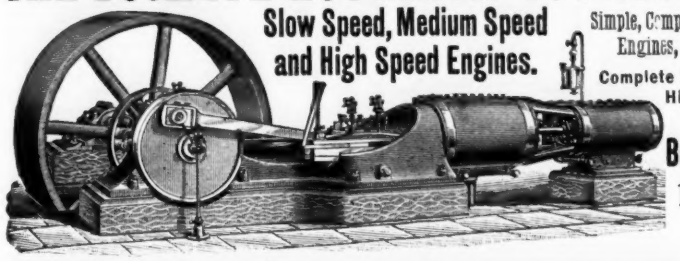

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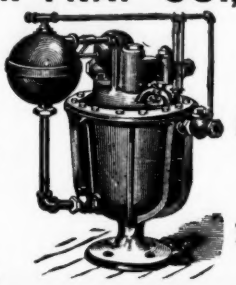

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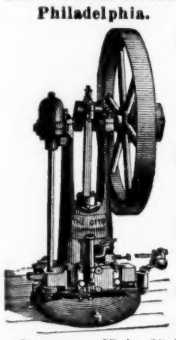

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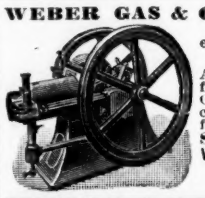

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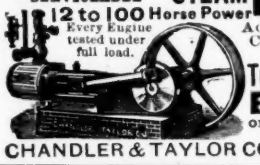

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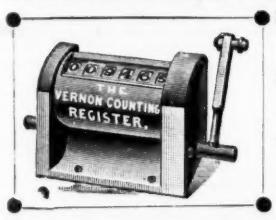

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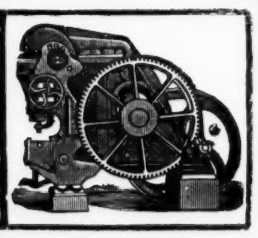

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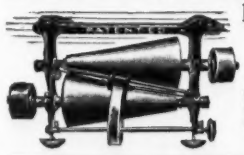

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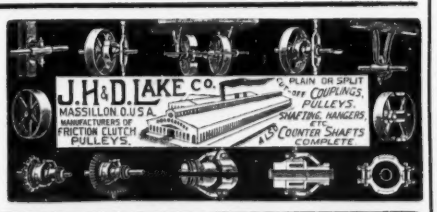
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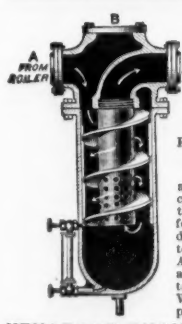

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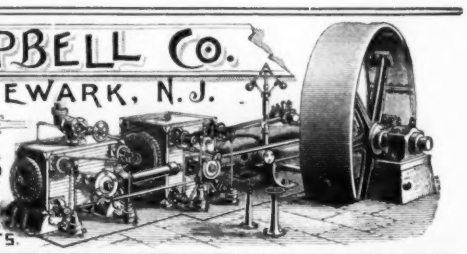

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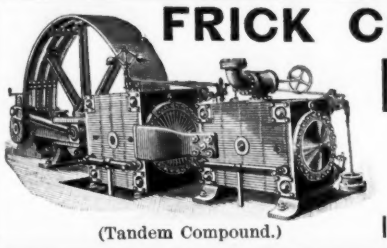

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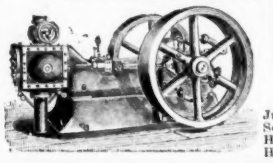

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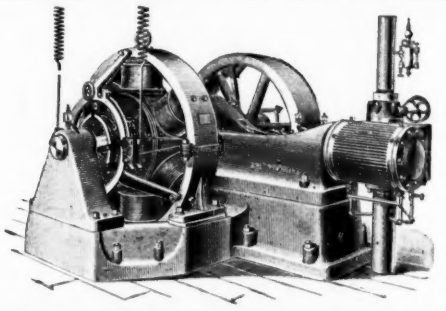

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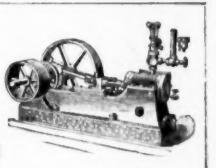

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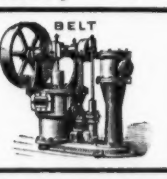

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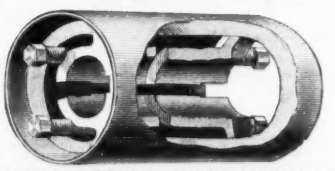

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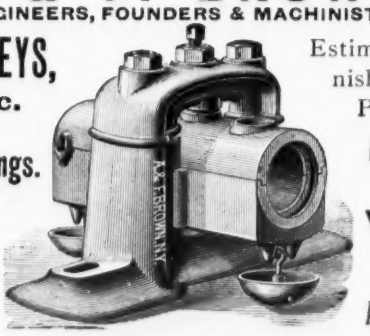

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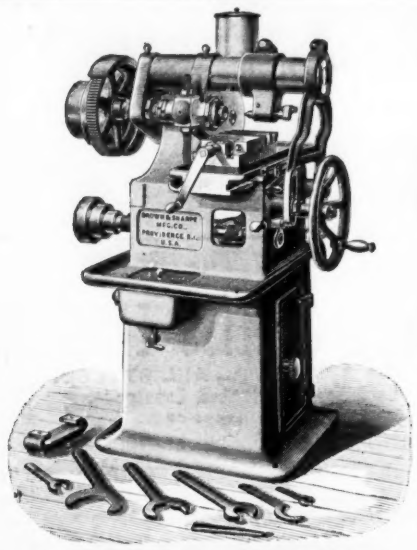

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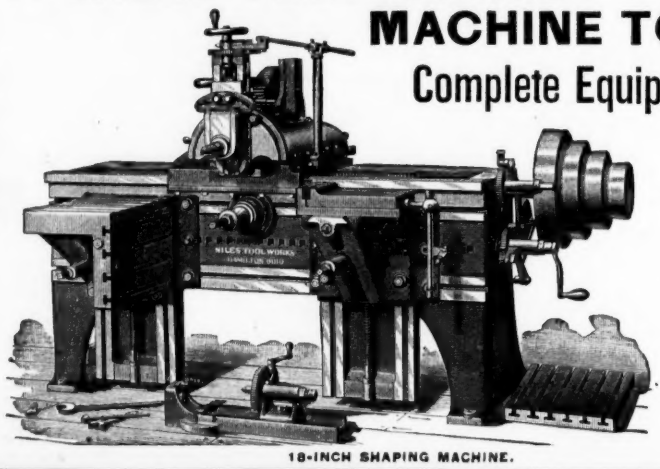

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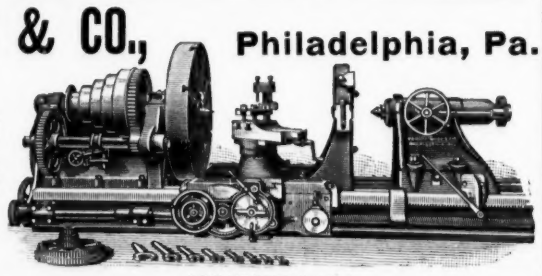

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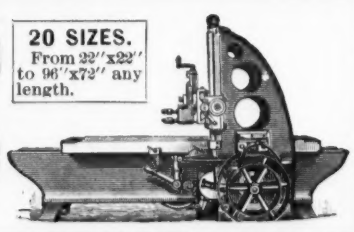

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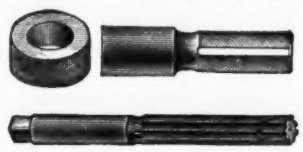

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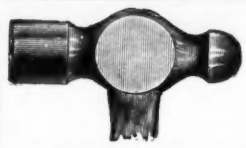

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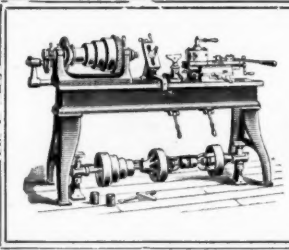

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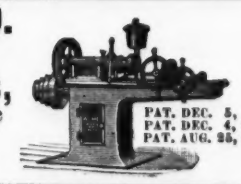

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